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KEY TO ADAMS'S NEW ARITHMETIC.
REVISED EDITION.

KEY

TO

ADAMS'S NEW ARITHMETIC.

REVISED EDITION,

FOR THE USE OF TEACHERS.

BY DANIEL ADAMS, M.D.
AUTHOR OF THE SCHOLAR'S ARITHMETIC, SCHOOL GEOGRAPHY, ETC.

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KEY.

¶60. CANCELATION.

4. $$\frac{\overset{\cancel{5}}{\cancel{35}} \times 5 \times 4 \times \overset{4}{\cancel{8}} \times \cancel{3}}{3 \times \cancel{7} \times \cancel{2} \times \underset{\cancel{3}}{\cancel{15}}} = \frac{80}{3} = 26\tfrac{2}{3} \text{ acres, } \textit{Ans.}$$

5. $$\frac{\overset{\overset{2}{\cancel{6}}}{\cancel{36}} \times 8 \times \cancel{4} \times 8 \times \cancel{2}}{\cancel{6} \times 5 \times \cancel{3} \times \cancel{4} \times \cancel{2}} = \frac{128}{5} = 25\tfrac{3}{5}, \textit{ Ans.}$$

6. $$\frac{\overset{9}{\cancel{27}} \times \overset{2}{\cancel{14}} \times \overset{\overset{2}{\cancel{8}}}{\cancel{40}} \times 8 \times \overset{\cancel{2}}{\cancel{6}}}{\cancel{7} \times \underset{5}{\cancel{10}} \times \underset{\cancel{4}}{\cancel{12}} \times \underset{\cancel{5}}{\cancel{15}}} = \frac{288}{5} = 57\tfrac{3}{5}, \textit{ Ans.}$$

7. $$\frac{\cancel{4} \times 7 \times \cancel{18} \times 10 \times \cancel{8} \times \overset{\cancel{3}}{\cancel{9}}}{\underset{\cancel{3}}{\cancel{24}} \times \underset{\cancel{4}}{\cancel{72}} \times \cancel{3}} = \frac{70}{1} = 70, \textit{ Ans.}$$

8. $$\frac{14 \times \cancel{5} \times \cancel{3} \times 28}{\underset{\cancel{3}}{\cancel{15}} \times 9} = \frac{392}{9} = 43\tfrac{5}{9}, \textit{ Ans.}$$

¶61. *To find a common divisor of two or more numbers.*

2. 4 = 4 × 1, 16 = 4 × 4, 24 = 4 × 6, 36 = 4 × 9, and 8 = 4 × 2; the common factor, 4, is the common divisor, *Ans.*

3. 22 = 11 × 2 = 22 × 1, 44 = 11 × 4 = 22 × 2, 66 = 11 × 6 = 22 × 3, and 88 = 11 × 8 = 22 × 4; the common divisor may be 11 or 22, *Ans.*

4. The length of the rod will be equal to the common measure of the lengths of the two pieces of cloth. 25 = 5 × 5, and 30 = 5 × 6; the length of the rod will be 5 feet, *An*

¶ 62. *To find the greatest common divisor of two or more numbers.*

1. 35 ÷ 21 = 1 and 14 rem.; 21 ÷ 14 = 1 and 7 rem.; and 14 ÷ 7 = 2; the greatest common divisor is 7, *Ans.*

2. 544 ÷ 96 = 5 and 64 rem.; 96 ÷ 64 = 1 and 32 rem.; and 64 ÷ 32 = 2; the greatest common divisor is 32, *Ans.*

3. 1184 ÷ 468 = 2 and 248 rem.; 468 ÷ 248 = 1 and 220 rem.; 248 ÷ 220 = 1 and 28 rem.; 220 ÷ 28 = 7 and 24 rem.; 28 ÷ 24 = 1 and 4 rem., and 24 ÷ 4 = 6; the greatest common divisor is 4, *Ans.*

4. 80 ÷ 32 = 2 and 16 rem.; 32 ÷ 16 = 2; 256 ÷ 16 = 16; the greatest common divisor is 16, *Ans.*

5. 200 ÷ 75 = 2 and 50 rem.; 75 ÷ 50 = 1 and 25 rem.; 50 ÷ 25 = 2; 625 ÷ 25 = 25; 150 ÷ 25 = 6; the greatest common divisor is 25, *Ans.*

6. The length of the chain will be equal to the greatest common divisor of the length and width of the field. 160 ÷ 100 = 1 and 60 rem.; 100 ÷ 60 = 1 and 40 rem.; 60 ÷ 40 = 1 and 20 rem., and 40 ÷ 20 = 2; the length of the chain is 20 rods, *Ans.*

7. The price per acre is equal to the greatest common divisor of all their sums of money. 2640 ÷ 1680 = 1 and 960 rem.; 1680 ÷ 960 = 1 and 720 rem.; 960 ÷ 720 = 1 and 240 rem.; 720 ÷ 240 = 3; 756 ÷ 240 = 3 and 36 rem.; 240 ÷ 36 = 6 and 24 rem.; 36 ÷ 24 = 1 and 12 rem.; 24 ÷ 12 = 2. They paid 12 dollars per acre; and A bought $\frac{2640}{12} = 220$ acres, B bought $\frac{1680}{12} = 140$ acres, and C bought $\frac{756}{12} = 63$ acres, *Ans.*

COMMON FRACTIONS.

¶ 66. EXAMPLES FOR PRACTICE.

11. $\frac{83}{6} = 83 \div 6 = 13\frac{5}{6}$ dollars, *Ans.*

12. $13 = \frac{78}{6}$, and $\frac{78}{6} + \frac{5}{6} = \frac{83}{6}$ of a dollar, *Ans.*

13. $\frac{1407}{60} = 1407 \div 60 = 23\frac{27}{60}$ hours, *Ans.*

14. $23 = \frac{1380}{60}$, and $\frac{1380}{60} + \frac{27}{60} = \frac{1407}{60}$ of an hour, *Ans.*

16. $730 = \frac{8760}{12}$, which $+ \frac{3}{12} = \frac{8763}{12}$ of a shilling, *Ans.*

18. $156 = \frac{3744}{24}$, which $+ \frac{17}{24} = \frac{3761}{24}$ of a day, *Ans.*

19. $\frac{1371}{4} = 1371 \div 4 = 342\frac{3}{4}$ gallons, *Ans.*

21. $\frac{86}{20} = 1\frac{16}{20}$, $\frac{706}{40} = 17\frac{26}{40}$, $\frac{875}{100} = 8\frac{75}{100}$, $\frac{4786}{1000} = 4\frac{786}{1000}$, and $\frac{3465}{450} = 7\frac{315}{450}$.

22. $1 = \frac{20}{20}$, which $+ \frac{16}{20} = \frac{36}{20}$; $17 = \frac{680}{40}$, which $+ \frac{26}{40} =$

$\frac{706}{40}$; $8=\frac{800}{100}$, which $+\frac{75}{100}=\frac{875}{100}$; $4=\frac{4000}{1000}$, which $+\frac{786}{1000}=\frac{4786}{1000}$; and $7=\frac{3150}{450}$, which $+\frac{315}{450}=\frac{3465}{450}$.

¶ 67. EXAMPLES FOR PRACTICE.

2. $6)\frac{156}{468}=2)\frac{26}{78}=13)\frac{13}{39}=\frac{1}{3}$, *Ans.*
3. $100)\frac{400}{500}=\frac{4}{5}$; $5)\frac{45}{600}=3)\frac{9}{120}=\frac{3}{40}$; &c.
4. $450)\frac{450}{900}=\frac{1}{2}$; $99)\frac{99}{297}=\frac{1}{3}$; $20)\frac{140}{160}=\frac{7}{8}$; $548)\frac{1644}{2192}=\frac{3}{4}$.
6. $57)\frac{114}{285}=\frac{2}{5}$, *Ans.*
8. $1429)\frac{1429}{2858}=\frac{1}{2}$, *Ans.*

ADDITION AND SUBTRACTION OF FRACTIONS.

¶ 70. EXAMPLES.

2. Each term of $\frac{1}{2}$ multiplied by $3\times8\times5=\frac{120}{240}$
" " " $\frac{2}{3}$ " " $2\times8\times5=\frac{160}{240}$
" " " $\frac{7}{8}$ " " $2\times3\times5=\frac{210}{240}$ } *Ans.*
" " " $\frac{4}{5}$ " " $2\times3\times8=\frac{192}{240}$

3. Each term of $\frac{1}{3}$ multiplied by $5\times4=\frac{20}{60}$.
" " " $\frac{3}{5}$ " " $3\times4=\frac{36}{60}$.
" " " $\frac{1}{4}$ " " $3\times5=\frac{15}{60}$.

And $\frac{20}{60}+\frac{36}{60}+\frac{15}{60}=\frac{71}{60}=1\frac{11}{60}$, *Ans.*

4. $\frac{3}{4}$ (multiplying both terms by 7) $=\frac{21}{28}$, and $\frac{6}{7}$ ($\times 4$) $=\frac{24}{28}$; then, $\frac{21}{28}+\frac{24}{28}=\frac{45}{28}=1\frac{17}{28}$, *Ans.*

5. Each term of $\frac{1}{2}$ multiplied by $3\times7\times5=\frac{105}{210}$.
" " " $\frac{1}{3}$ " " $2\times7\times5=\frac{70}{210}$.
" " " $\frac{1}{7}$ " " $2\times3\times5=\frac{30}{210}$.
" " " $\frac{1}{5}$ " " $2\times3\times7=\frac{42}{210}$.

Then $\frac{105}{210}+\frac{70}{210}+\frac{80}{210}+\frac{42}{210}=\frac{247}{210}=1\frac{37}{210}$, *Ans.*

6. $\frac{3}{4}$ (multiplying both terms by 6) $=\frac{18}{24}$, and $\frac{5}{6}$ ($\times 4$) $=\frac{20}{24}$; or $\frac{3}{4}$ ($\times 3$) $=\frac{9}{12}$, and $\frac{5}{6}$ ($\times 2$) $=\frac{10}{12}$, *Ans.*

¶ 72. NOTE. The *least* common multiple of two or more numbers, *is the least number which contains all the prime factors of those numbers.* Hence, *to find the least common multiple, or common denominator, of two or more numbers*, it is simply necessary to resolve those numbers into their *prime factors*, by dividing them continually and successively, by the primes, 2, 3, 5, 7, 11, 13, &c., until the last quotients terminate in units. The product of all the prime divisors will be the least common multiple.

2)	2	4	6	8	10
2)	1	2	3	4	5
2)	1	1	3	2	5
3)	1	1	3	1	5
5)	1	1	1	1	5
	1	1	1	1	1

We may take Ex. 1 of the Arithmetic for an illustration. Find the least common denominator of $\frac{1}{2}$, $\frac{3}{4}$, $\frac{2}{5}$, $\frac{5}{8}$, $\frac{7}{10}$. The prime divisors, $2\times2\times2\times3\times5=120$, *Ans.*

¶ 74. EXAMPLES FOR PRACTICE.

NOTE. — Let the pupil be thoroughly drilled by the teacher in the six preceding sections before attempting to work the following examples by himself.

1. $\frac{6}{7}$ (multiplying both terms by three) $=\frac{18}{21}$, and $\frac{2}{3}$ ($\times$ 7) $=\frac{14}{21}$; then $\frac{18}{21}+4\frac{14}{21}+12=16\frac{32}{21}=17\frac{11}{21}$, *Ans.*

2. Whole ticket $=\frac{8}{8}$; then, $\frac{8}{8}-\frac{3}{8}=\frac{5}{8}$, *Ans.*

3. The least common multiple (¶ 73, note 2,) of 2, 8, 4, 10, 5, 20, is 40; then, (¶ 73, ex. 1,) $\frac{20}{40}+\frac{25}{40}+\frac{10}{40}+\frac{28}{40}+\frac{8}{40}+\frac{28}{40}=2\frac{39}{40}$, *Ans.*

4. When the numbers are small, fractions are readily reduced to a common denominator *mentally*, without the formality of a written operation. Thus, in this example, the fraction $\frac{9}{11}$ is readily reduced to 33ds, considering both terms to be multiplied by 3; we then have $16\frac{7}{33}-14\frac{24}{33}=1\frac{16}{33}$, *Ans.*

5. $1\frac{1}{2}-\frac{3}{4}=1\frac{2}{4}-\frac{3}{4}=\frac{3}{4}$; or $1\frac{1}{2}-\frac{3}{4}=\frac{6}{4}-\frac{3}{4}=\frac{3}{4}$, *Ans.*

6. $3-\frac{1}{3}=\frac{9}{3}-\frac{1}{3}=\frac{8}{3}=2\frac{2}{3}$, *Ans.*

7. $147\frac{1}{3}-48\frac{4}{9}=147\frac{3}{9}-48\frac{4}{9}=98\frac{8}{9}$, *Ans.*

8. 112 ($\frac{1}{2}=$) $\frac{6}{12}+311$ ($\frac{2}{3}=$) $\frac{8}{12}+1000$ ($\frac{3}{4}=$) $\frac{9}{12}=1424\frac{11}{12}$, *Ans.*

9. $14+11+4$ ($\frac{2}{3}=$) $\frac{12}{18}+\frac{1}{18}+$ ($\frac{1}{2}=$) $\frac{9}{18}=30\frac{2}{9}$, *Ans.*

10. $\frac{3}{4}-$ ($\frac{1}{2}=$) $\frac{2}{4}=\frac{1}{4}$; $\frac{7}{8}-$ ($\frac{3}{4}=$) $\frac{6}{8}=\frac{1}{8}$, *Ans.*

11. ($\frac{1}{2}=$) $\frac{3}{6}-$ ($\frac{1}{3}=$) $\frac{2}{6}=\frac{1}{6}$; ($\frac{2}{3}=$) $\frac{4}{6}-$ ($\frac{1}{2}=$) $\frac{3}{6}=\frac{1}{6}$, &c.

12. ($1=$) $\frac{4}{4}-\frac{1}{4}=\frac{3}{4}$; ($3\frac{4}{5}=\frac{19}{5}=$) $\frac{38}{10}-\frac{1}{10}=\frac{37}{10}=3\frac{7}{10}$; ($1000=$) $\frac{10000}{10}-\frac{1}{10}=\frac{9999}{10}=999\frac{9}{10}$, *Ans.*

MULTIPLICATION OF FRACTIONS.

¶ 75. EXAMPLES FOR PRACTICE.

1. $\frac{5}{36}\times 18=$ (divide the denominator) $\frac{5}{2}=2\frac{1}{2}$ barrels. $\frac{5}{36}\times 6=\frac{5}{6}$ barrel. $\frac{5}{36}\times 9=\frac{5}{4}=1\frac{1}{4}$ barrels, *Ans.*

2. $\frac{71}{120}\times 40=\frac{71}{3}=23\frac{2}{3}$, *Ans.*

3. $\frac{13}{144}\times 12=\frac{13}{12}=1\frac{1}{12}$; $\frac{13}{144}\times 18=\frac{13}{8}=1\frac{5}{8}$; $\frac{13}{144}\times 21=\frac{273}{144}=1\frac{129}{144}$; $\frac{13}{144}\times 36=\frac{13}{4}=3\frac{1}{4}$; $\frac{13}{144}\times 48=\frac{13}{3}=4\frac{1}{3}$; $\frac{13}{144}\times 60=$ $5\frac{60}{144}=5\frac{5}{12}$; or multiply by the component parts, $12\times 5=60$, as shown in the Arithmetic, *Ans.*

5. $17\times 9=153$ dollars, and $17\times\frac{13}{20}=\frac{221}{20}=11\frac{1}{20}$ dollars; then, 153 dollars $+\,11\frac{1}{20}$ dollars $=164\frac{1}{20}$ dollars, *Ans*

6. $2\frac{6}{40}\times 5=10\frac{6}{8}$ mi.; $2\frac{6}{40}\times 8=16\frac{6}{5}=17\frac{1}{5}$ mi.; $2\frac{6}{40}\times 12=24\frac{72}{40}=25\frac{32}{40}=25\frac{4}{5}$; $25\frac{4}{5}\times 3=77\frac{2}{5}$ miles, *Ans.*

¶ 76. 2. $90 \times \frac{1}{2} = \frac{90}{2} = 45$, *Ans.*
3. $369 \times \frac{2}{3} = (369 \div 3 = 123$, and $123 \times 2 =) 246$, *Ans.*
4. $45 \times \frac{7}{10} = (45 \times 7 = 315$, and $315 \div 10 =) 31\frac{1}{2}$, *Ans.*
5. $210 \times \frac{4}{9} = \frac{840}{9} = 93\frac{1}{3}$, *Ans.*
6. $1326 \times \frac{2}{11} = \frac{2652}{11} = 241\frac{1}{11}$, *Ans.*

¶ 77. EXAMPLES FOR PRACTICE.

2. $1367 \times \frac{2}{9}$. $\frac{1}{9}$ of $1367 = 151\frac{8}{9}$, and $\frac{2}{9} = 151\frac{8}{9} \times 2 = 303\frac{7}{9}$ dollars, *Ans.*

3. $225 \times \frac{11}{13}$. $\frac{1}{13}$ of $225 = 17\frac{4}{13}$, and $\frac{11}{13} = 17\frac{4}{13} \times 11 = 190\frac{5}{13}$ dollars, *Ans.*

¶ 78. EXAMPLES FOR PRACTICE.

2. $\frac{7}{8} \times \frac{6}{7} = \frac{42}{56} = \frac{3}{4}$, *Ans.* $\frac{9}{10} \times \frac{2}{7} = \frac{18}{70} = \frac{9}{35}$, *Ans.*
3. $\frac{6}{25} \times \frac{7}{8} = \frac{42}{200} = \frac{21}{100}$ of a dollar, *Ans.*
5. $7\frac{3}{4} = \frac{31}{4}$; then $\frac{5}{6} \times \frac{31}{4} = \frac{155}{24} = 6\frac{11}{24}$ dollars, *Ans.*
6. $2\frac{1}{4} \times 6\frac{5}{8} = \frac{9}{4} \times \frac{53}{8} = \frac{477}{32} = 14\frac{29}{32}$ dollars, *Ans.*

¶ 79. 2. $\frac{3}{5}$ of $\frac{7}{8} = \frac{21}{40}$. $\frac{3}{7}$ of $\frac{2}{13} = \frac{6}{91}$. $\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{6}$, *Ans.*
4. $\frac{5}{13}$ of $\frac{2}{9}$ of $\frac{3}{4}$ of $\frac{6}{8} = \frac{180}{3744} = \frac{5}{104}$, *Ans.*
5. $\frac{4}{5}$ of $\frac{2}{3}$ of $\frac{7}{8}$ of $\frac{3}{4} = \frac{168}{480} = \frac{7}{20}$, *Ans.*

¶ 80. EXAMPLES FOR PRACTICE IN CANCELATION.

2. $\frac{3}{\cancel{4}}$ of $\frac{\cancel{4}}{\cancel{5}}$ of $\frac{\cancel{6}}{\cancel{7}}$ of $\frac{\cancel{5}}{\cancel{6}}$ of $\frac{\cancel{9}}{10}$ of $\frac{\cancel{7}}{\cancel{8}}$ of $\frac{\cancel{8}}{\cancel{9}} = \frac{3}{10}$, *Ans.*

3. $\frac{\cancel{7}}{1} \times \frac{1}{2} \times \frac{5}{\cancel{7}}$ of $\frac{\cancel{3}}{\underset{2}{\cancel{8}}} \times \frac{\overset{7}{\cancel{28}}}{\underset{3}{\cancel{9}}} = \frac{35}{12} = 2\frac{11}{12}$, *Ans.*

4. $\frac{\cancel{3}}{1} \times \frac{\cancel{2}}{\cancel{5}} \times \frac{\cancel{5}}{\underset{\cancel{3}}{\cancel{9}}}$ of $\frac{\cancel{3}}{\cancel{4}} \times (2\frac{5}{7} =) \frac{19}{7} \times \frac{11}{\underset{\cancel{2}}{\cancel{12}}}$ of $\frac{\cancel{6}}{7}$ of $\frac{\cancel{4}}{5} = \frac{209}{245}$, *Ans.*

5. $\frac{\cancel{3}}{\underset{2}{\cancel{4}}}$ of $\frac{\cancel{4}}{\cancel{5}}$ of $\frac{\cancel{6}}{7}$ of $\frac{\cancel{5}}{\cancel{6}}$ of $\frac{199}{\underset{3}{\cancel{9}}} = \frac{199}{21} = 9\frac{10}{21}$, *Ans.*

6. $\frac{\cancel{6}}{7}$ of $\frac{1}{\cancel{3}}$ of $\frac{8}{1} = \frac{16}{7} = 2\frac{2}{7}$ tons, *Ans.*

7. $\frac{\cancel{7}}{\cancel{8}}$ of $\frac{\cancel{3}}{4}$ of $\frac{\cancel{6}}{\cancel{7}}$ of $\frac{5}{\cancel{6}}$ of $\frac{\cancel{8}}{\underset{3}{\cancel{9}}}$ of $\frac{1}{1} = \frac{5}{12}$, *Ans.*

¶ 80. (2.) PROMISCUOUS EXAMPLES IN THE MULTIPLICATION OF FRACTIONS.

3. $2\frac{9}{10}$ $(=\frac{29}{10}) \times 3=\frac{87}{10}=8\frac{7}{10}$ tons, or (multiplying the integers and the fraction separately) $2 \times 3=6$, and $\frac{9}{10} \times 3 =\frac{27}{10}=2\frac{7}{10}$; then, $2\frac{7}{10}+6=8\frac{7}{10}$ tons, &c.

4. 3 dollars $\times 8\frac{7}{12}=25\frac{3}{4}$ dollars, *Ans.*

5. $14\frac{3}{4}$ dollars $\times 147=2168\frac{1}{4}$ dollars, *Ans.*

6. 1000 dollars $\times \frac{3}{5}$ $(\div 5=200$ dollars, or $\frac{1}{5}$, which $\times$ $3)=600$ dollars, or $\frac{3}{5}$, which is A's share; 1000 dollars $\times$ $(\frac{6}{15}=)$ $\frac{2}{5}$ $(\div 5$, &c., as before$)=400$ dollars, which is B's share.

7. $\frac{1}{\cancel{2}}$ of $\frac{\cancel{2}}{3}=\frac{1}{3}$, $\frac{3}{\cancel{4}}$ of $\frac{\cancel{4}}{5}=\frac{3}{5}$, and $\frac{1}{\cancel{3}} \times \frac{\cancel{3}}{5}=\frac{1}{5}$, *Ans.*; or, $\frac{1}{\cancel{2}}$ of $\frac{\cancel{2}}{\cancel{3}} \times \frac{\cancel{3}}{\cancel{4}}$ of $\frac{\cancel{4}}{5}=\frac{1}{5}$, *Ans.*, as before.

12. $\frac{1}{9}$ of $\frac{8}{1}=\frac{8}{9}$, $\frac{2}{3}$ of $\frac{7}{1}=\frac{14}{3}$, $\frac{3}{8}$ of $\frac{9}{1}=\frac{27}{8}$, and $\frac{1}{7}$ of $\frac{10}{1}=\frac{10}{7}$; then, $\frac{\overset{2}{\cancel{8}}}{\cancel{9}} \times \frac{\cancel{14}}{\cancel{3}} \times \frac{\overset{\cancel{9}}{\cancel{27}}}{\cancel{8}} \times \frac{10}{\cancel{7}}=20$, *Ans.*; or, $\frac{1}{\cancel{9}}$ of $\frac{\cancel{8}}{1} \times \frac{2}{\cancel{3}}$ of $\frac{\cancel{7}}{1} \times \frac{\cancel{3}}{\cancel{8}}$ of $\frac{\cancel{9}}{1} \times \frac{1}{\cancel{7}}$ of $\frac{10}{1}=20$, *Ans.*, as before.

DIVISION OF FRACTIONS.

¶ 81. EXAMPLES FOR PRACTICE.

9. $\frac{19}{20} \div 24=\frac{19}{480}$ of an acre, *Ans.*

10. $\frac{10}{11} \div 12=\frac{10}{132}$ of a dollar, *Ans.*

12. $\frac{4}{10} \div 12=\frac{4}{120}=\frac{1}{30}$, *Ans.* $\frac{7}{40} \div 21=\frac{7}{840}=\frac{1}{120}$. *Ans.* $\frac{36}{49} \div 24=\frac{36}{1176}=\frac{3}{98}$, *Ans.*

14. $(4\frac{11}{13}=)$ $\frac{63}{13} \div 9=\frac{7}{13}$ of a dollar, *Ans.*

15. $(12\frac{6}{7}=)$ $\frac{90}{7} \div 5=\frac{18}{7}=2\frac{4}{7}$, *Ans.*

16. $(14\frac{3}{4}=)$ $\frac{59}{4} \div 8=\frac{59}{32}=1\frac{27}{32}$, *Ans.*

18. $2786\frac{1}{4} \div 6=464$, and $2\frac{1}{4}$ remain. $=\frac{9}{4} \div 6=\frac{9}{24}=\frac{3}{8}$; then, $464+\frac{3}{8}=464\frac{3}{8}$, *Ans.*

19. $7646\frac{11}{24} \div 24=318$, rem. $14\frac{11}{24}=\frac{347}{24} \div 24=\frac{347}{576}$; then, $318+\frac{347}{576}=318\frac{347}{576}$, *Ans.*

20. $462\frac{1}{3} \div 3=154\frac{1}{9}$, *Ans.*

¶ 82. EXAMPLES FOR PRACTICE.

2. $7 \div \frac{1}{2} = (7 \times 2 = 14$, which $\div 1 =)$ 14 times, *Ans.*
3. $26 \div \frac{1}{4} = 104$ times, *Ans.*
4. $3 \div \frac{3}{4} = (3 \times 4 = 12$, which $\div 3 =)$ 4; $6 \div \frac{2}{3} = 9$; $10 \div \frac{2}{5} = 25$, *Ans.*
5. (3 gal. =) 12 quarts $\div \frac{9}{16} = (12 \times 16 = 192$, which $\div 9 =)$ $21\frac{1}{3}$ days, *Ans.*
6. $22 \div (2\frac{3}{4} =)$ $\frac{11}{4} = (22 \times 4 = 88$, which $\div 11 =)$ 8 acres, *Ans.*
7. $6 \div \frac{36}{5} = (\times 5$ and $\div 36 =)$ $\frac{5}{6}$ of 1 time, *Ans.*
8. $53 \div (8\frac{5}{9} =)$ $\frac{77}{9} = (\times 9$ and $\div 77 =)$ $6\frac{15}{77}$ times, *Ans.*

¶ 83. EXAMPLES FOR PRACTICE.

2. $37 \div (4\frac{2}{5} =)$ $\frac{22}{5} = (\times 5$ and $\div 22 =)$ $8\frac{9}{22}$ yards, *Ans.*
3. $84 \div \frac{96}{103} = (\times 103$ and $\div 96 =)$ $90\frac{1}{8}$ pounds, *Ans.*
4. $87 \div \frac{5}{6} = 104\frac{2}{5}$ rods, *Ans.*

¶ 84. EXAMPLES FOR PRACTICE.

4. $(36\frac{7}{8} =)$ $\frac{295}{8} \div (4\frac{3}{5} =)$ $\frac{23}{5}$ $(\frac{5}{23}$ of $\frac{295}{8}) = \frac{1475}{184} = 8\frac{3}{184}$ weeks, *Ans.*
5. $(2\frac{1}{4} =)$ $\frac{9}{4} \div (1\frac{1}{2} =)$ $\frac{3}{2} = \frac{18}{12} = 1\frac{1}{2}$, *Ans.*; $(10\frac{3}{8} =)$ $\frac{83}{8} \div (2\frac{1}{8} =)$ $\frac{17}{8} = \frac{664}{136} = 4\frac{15}{17}$, *Ans.*
6. $\frac{2}{5} \div \frac{1}{10}$ $(\frac{10}{1}$ of $\frac{2}{5}) = \frac{20}{5} = 4$, *Ans.*
7. $(4\frac{7}{8} =)$ $\frac{39}{8} \div \frac{3}{7}$ $(\frac{7}{3}$ of $\frac{39}{8}) = \frac{273}{24} = 11\frac{3}{8}$, *Ans.*
8. $(\frac{2}{3}$ of $\frac{3}{4} = \frac{6}{12} =)$ $\frac{1}{2} \div (\frac{7}{8}$ of $\frac{1}{7} = \frac{7}{56} =)$ $\frac{1}{8}$ $(\frac{8}{1}$ of $\frac{1}{2}) = \frac{8}{2} = 4$, *Ans.*; or, $\frac{2}{3}$ of $\frac{3}{4} \div \frac{7}{8}$ of $\frac{1}{7} = (\frac{2}{\cancel{3}}$ of $\frac{\cancel{3}}{\cancel{4}} \times \frac{\overset{2}{\cancel{8}}}{\cancel{7}}$ of $\frac{\cancel{7}}{1} =)$ 4, *Ans.*, as before.

¶ 85. EXAMPLES FOR PRACTICE.

2. $\frac{7}{8} \div (3\frac{1}{2} =)$ $\frac{7}{2} = (\frac{\cancel{7}}{\underset{4}{\cancel{8}}} \times \frac{\cancel{2}}{\cancel{7}} =)$ $\frac{1}{4}$ of a dollar, *Ans.*
3. $\frac{7}{8}$ of a dollar $\div (4\frac{2}{3} =)$ $\frac{14}{3} = (\frac{\cancel{7}}{8} \times \frac{3}{\underset{2}{\cancel{14}}} =)$ $\frac{3}{16}$ of a dollar, *Ans.*

¶ 85. (2.) EXAMPLES FOR PRACTICE.

3. $(7\frac{1}{5}=)\ \frac{36}{5}\div\frac{3}{9}=(\frac{\overset{12}{\cancel{36}}}{5}\times\frac{9}{\cancel{3}}=)\ \frac{108}{5}=21\frac{3}{5}$, *Ans.*

4. $(6\frac{3}{9}=)\ \frac{57}{9}\div\frac{1}{3}=(\frac{\overset{19}{\cancel{57}}}{\underset{3}{\cancel{9}}}\times\frac{\cancel{3}}{1}=)$ 19, *Ans.*

5. $(3\frac{4}{7}=)\frac{25}{7}\div 9=(\frac{25}{7}\times\frac{1}{9}=)\ \frac{25}{63}$, *Ans.*
6. $\frac{7}{12}\div(4\frac{3}{5}=)\ \frac{23}{5}=(\frac{7}{12}\times\frac{5}{23}=)\ \frac{35}{276}$, *Ans.*
7. $(7\frac{11}{16}=)\ \frac{123}{16}\ \div\ (9\frac{2}{3}=)\ \frac{29}{3}\ =\ (\frac{123}{16}\times\frac{3}{29}\ =)\ \frac{369}{464}$, *Ans.*
8. $10\div\frac{3}{8}=(\times 8$ and $\div 3=)\ \frac{80}{3}=26\frac{2}{3}$, *Ans.*
9. $5\div(7\frac{2}{3}=)\ \frac{23}{3}=(\times 3$ and $\div 23=)\ \frac{15}{23}$, *Ans.*
10. $\frac{6}{24}\div 16=\frac{6}{\underset{3}{384}}=\frac{1}{64}$, *Ans.*

11. $\frac{2}{\cancel{3}}$ of $\frac{4}{5}$ of $\frac{\overset{3}{\cancel{9}}}{1}=\frac{24}{5}$, $(3\frac{7}{10}=)\ \frac{37}{10}\times(2\frac{1}{3}=)\ \frac{7}{3}=\frac{259}{30}$;

then, $\frac{24}{5}\div\frac{259}{30}=(\frac{24}{\cancel{5}}\times\frac{\overset{6}{\cancel{30}}}{259}=)\ \frac{144}{259}$, *Ans.*

¶ 85. (3.) PROMISCUOUS EXAMPLES IN THE DIVISION OF FRACTIONS.

NOTE. In the first six of the following examples, let the pupil consult ¶¶ 77, 83, and 85, and make the several distinctions.

1. $\frac{63}{100}$ of a dollar (cost) $\div$ 7 (lb., the quantity) $=\frac{9}{100}$ of a dollar, the price of unity, or 1 lb., *Ans.*
2. $\frac{1}{8}$ of a dollar (cost) $\div\frac{3}{8}$ (of a barrel, the quantity) $=$ $(\frac{\cancel{8}}{3}$ of $\frac{1}{\cancel{8}}=)\ \frac{1}{3}$ of a dollar, the price of unity, or 1 barrel, *Ans.*
3. $\frac{7}{8}$ of a dollar $\div 4=\frac{7}{32}$ of a dollar, *Ans.*
4. 4 dollars $\div\frac{7}{8}$ (of a yard) $=$ ($4\frac{4}{7}$ dollars, *Ans.*
5. 75 dollars $\div(14\frac{3}{8}=)\ \frac{115}{8}\ (\times 8$ and $\div 115)=5\frac{5}{23}$ dollars, *Ans.*

6. $(31\frac{1}{2}=)\ \frac{63}{2}$ of a dollar $\div(10\frac{1}{2}=)\ \frac{21}{2}\ (\frac{\cancel{2}}{\cancel{21}}$ of $\frac{\overset{3}{\cancel{63}}}{\cancel{2}})=3$ dollars per barrel, *Ans.*

8. $(\frac{1}{\cancel{2}}$ of $\frac{\cancel{2}}{3}=)\ \frac{1}{3}\div\frac{3}{4}\ (\frac{4}{3}$ of $\frac{1}{3})=\frac{4}{9}$; $\frac{7}{8}\div(\frac{4}{7}$ of $\frac{2}{5}=)\ \frac{8}{35}$
35 of $\frac{7}{8})=\frac{245}{64}=3\frac{53}{64}$, *Ans.*

9. $(\frac{1}{\cancel{2}} \text{ of } \frac{\overset{2}{\cancel{4}}}{5} =) \frac{2}{5} \div (\frac{5}{\underset{3}{\cancel{6}}} \text{ of } \frac{\cancel{2}}{3} =) \frac{5}{9}\ (\frac{9}{5} \text{ of } \frac{2}{5}) = \frac{18}{25}$, *Ans.*

10. $(\frac{1}{5} \text{ of } \frac{4}{1} =) \frac{4}{5} \div \frac{4}{15} (\frac{\overset{3}{\cancel{15}}}{\cancel{4}} \text{ of } \frac{\cancel{4}}{\cancel{5}}) = 3$, *Ans.*

11. $(4\frac{5}{9} =) \frac{41}{9} \div (\frac{5}{9} \text{ of } \frac{4}{1} =) \frac{20}{9}\ (\frac{\cancel{9}}{20} \text{ of } \frac{41}{\cancel{9}}) = 2\frac{1}{20}$, *Ans.*

12. $(\frac{5}{9} \text{ of } \frac{4}{1} =) \frac{20}{9} \div (4\frac{5}{9} =) \frac{41}{9} (\frac{\cancel{9}}{41} \text{ of } \frac{20}{\cancel{9}} = \frac{41}{20}) = \frac{20}{41}$, *Ans.*

13. $(8\frac{3}{7} =) \frac{59}{7} \div (9\frac{2}{5} =) \frac{47}{5} = (\frac{59}{7} \times \frac{5}{47} \times) \frac{295}{329}$; $\frac{2}{3} \div 7 = \frac{2}{21}$; then $\frac{295}{329} \div \frac{2}{21} = (\frac{295}{\underset{47}{\cancel{329}}} \times \frac{\overset{3}{\cancel{21}}}{2} =) \frac{885}{94} = 9\frac{39}{94}$, *Ans.*

¶ 86. REVIEW OF COMMON FRACTIONS.

EXERCISES.

1. $\frac{5}{6} + \frac{3}{8} = \frac{40+18}{48} = \frac{58}{48} = 1\frac{10}{48}$, *Ans.* $\frac{1}{2} \times \frac{2}{3} = \frac{3+2}{6} = \frac{5}{6}$, *Ans.* $(12\frac{1}{2} =) 12\frac{6}{12} + (3\frac{2}{3} =) 3\frac{8}{12} + (4\frac{3}{4} =) 4\frac{9}{12} = 20\frac{11}{12}$, *Ans.*

2. $\frac{1}{4} - \frac{1}{8} = \frac{2-1}{8} = \frac{1}{8}$, *Ans.* $\frac{3}{10} - \frac{1}{5} = \frac{3-2}{10} = \frac{1}{10}$, *Ans.* $\frac{3}{14} - \frac{8}{40} = \frac{60-56}{280} = \frac{4}{280} = \frac{1}{70}$, *Ans.* $(14\frac{1}{2} =) 14\frac{7}{14} - (4\frac{1}{7} =) 4\frac{2}{14} = 10\frac{5}{14}$, *Ans.* $6 - 4\frac{3}{8} = 1\frac{5}{8}$, *Ans.* $\frac{109}{110} - (\frac{1}{\cancel{2}} \text{ of } \frac{\cancel{2}}{\cancel{3}} \text{ of } \frac{\cancel{3}}{4} =) \frac{1}{4} = \frac{218-55}{220} = \frac{163}{220}$, *Ans.*

3. $\frac{5}{6} - \frac{2}{5} = \frac{25-12}{30} = \frac{13}{30}$, *Ans.*

4. $\frac{3}{5} + \frac{1}{8} = \frac{24+5}{40} = \frac{29}{40}$, *Ans.*

5. $21 \times \frac{3}{4} = 15\frac{3}{4}$, *Ans.*

6. $\frac{1}{4} \div \frac{2}{3} = (\frac{1}{4} \times \frac{3}{2} =) \frac{3}{8}$, *Ans.*

7. 12 must be the remaining $\frac{3}{5}$ of the number. $12 \div 3 = 4 =$ one fifth of the number, which $\times 5 = 20$, *Ans.*

8. $(\frac{2}{\cancel{5}} \text{ of } \frac{\cancel{5}}{3} \text{ of } 1 =) \frac{2}{3} + \frac{3}{3} = \frac{5}{3}$; 20 is $\frac{5}{3}$ of the number. $20 \div 5 = 4 =$ one third of the number, which $\times 3 = 12$, *Ans.*

9. $9 \div 2 = 4\frac{1}{2} =$ one third of the number, which $\times 3 = 13\frac{1}{2}$, *Ans.*

10. $\frac{3}{4}$ of 1 yard will cost $\frac{3}{4}$ of $\frac{5}{8}$ of a dollar $= \frac{15}{32}$ of a dollar *Ans.*

11. $(5\frac{6}{7}=)\frac{41}{7}\times(18\frac{1}{2}=)\frac{37}{2}=\frac{1517}{14}=108\frac{5}{14}$ dollars, *Ans*

12. $\frac{3}{22}\times 84=\frac{252}{22}=11\frac{5}{11}$ dollars, *Ans.*

13. $\frac{5}{8}\times 45=\frac{225}{8}=28\frac{1}{8}$ dollars, *Ans.*

14. $5\times\frac{7}{16}=\frac{35}{16}=2\frac{3}{16}$ dollars, *Ans.*

15. $\frac{11}{15}\div\frac{7}{8}=(\frac{11}{15}\times\frac{8}{7}=)\frac{88}{105}$ of a dollar, *Ans.*

16. $(73\frac{4}{5}=)\frac{369}{5}\div(7\frac{1}{5}=)\frac{36}{5}=(\frac{\overset{41}{\cancel{369}}}{\cancel{5}}\times\frac{\cancel{5}}{\underset{4}{\cancel{36}}}=)\frac{41}{4}=10\frac{1}{4}$ dollars, *Ans.*

17. $82\frac{9}{16}\div 4=20$, and $2\frac{9}{16}=\frac{41}{16}$ remain., which $\div 4=\frac{41}{64}$; then, $20+\frac{41}{64}=20\frac{41}{64}$ dollars, *Ans.*

18. $\frac{5}{12}\div 3\frac{1}{2}=(\frac{5}{\underset{6}{\cancel{12}}}\times\frac{\cancel{2}}{7}=)\frac{5}{42}$ of a dollar, *Ans.*

19. $4\frac{3}{8}\div\frac{3}{20}=\frac{35}{\underset{2}{\cancel{8}}}\times\frac{\overset{5}{\cancel{20}}}{3}=\frac{175}{6}=29\frac{1}{6}$ pounds, *Ans.*

20. $82\frac{3}{4}\div 1\frac{2}{5}=\frac{331}{4}\times\frac{5}{7}=\frac{1655}{28}=59\frac{3}{28}$ bushels, *Ans.*

21. $8\frac{3}{4}\times 9=78\frac{3}{4}$ yards in 9 dresses; then $80-78\frac{3}{4}=1\frac{1}{4}$ yards in the remnant, *Ans.*

22. $22=176$ eighths, which $\div$ 7 eighths $=25$, and 1 remainder, which is $\frac{1}{8}$ of a yard. *Ans.*, 25 vests. Remnant, $\frac{1}{8}$ of a yard.

23. $\frac{3}{4}\div 15=\frac{3}{60}=\frac{1}{20}$, *Ans.*

24. $\frac{\cancel{2}}{8}$ of $\frac{7}{\underset{5}{\cancel{10}}}=\frac{7}{40}$, which $\div 7=\frac{1}{40}$; $6\div(3\frac{4}{11}=)\frac{37}{11}=\frac{6}{1}\times\frac{11}{37}=\frac{66}{37}$; then, $\frac{1}{\underset{20}{\cancel{40}}}\times\frac{\overset{33}{\cancel{66}}}{37}=\frac{33}{740}$, *Ans.*

25. $72=2\times2\times2\times3\times3$.
$8=2\times2\times2$, all the factors are factors of 72.
$9=3\times3$, " " " " " " "
$11=11\times1$, " " " not " " "
$12=2\times2\times3$, " " " are " " "
$14=2\times7$, " " " not " " "
$15=3\times5$, " " " " " " "
$16=2\times2\times2\times2$, " " " " " " "
$18=2\times3\times3$, " " " are " " "
$20=2\times2\times5$, " " " not " " "
$22=2\times11$, " " " " " " "
$24=2\times2\times2\times3$, " " " are " " "
ns., 8, 9, 12, 18, 24.

26. $\frac{3}{4}$ of $9\frac{2}{3}=\frac{\cancel{3}}{4}$ of $\frac{29}{\cancel{3}}=\frac{29}{4}$, $\frac{8}{11}$ of $16=\frac{128}{11}$, and $\frac{29}{4}\div\frac{128}{11}=\frac{29}{4}\times\frac{11}{128}=\frac{319}{512}$; $\frac{\cancel{2}}{6}$ of $\frac{1}{3}$ of $(2\frac{1}{2}=)\ \frac{5}{\cancel{2}}=\frac{5}{18}$, $\frac{1}{4}$ of $(19\frac{1}{2}=)\ \frac{39}{2}=\frac{39}{8}$, and $\frac{5}{18}\div\frac{39}{8}=\frac{5}{\underset{9}{\cancel{18}}}\times\frac{\overset{4}{\cancel{8}}}{39}=\frac{20}{351}$; then, $\frac{319}{512}\div\frac{20}{351}=\frac{319}{512}\times\frac{351}{20}=\frac{111969}{10240}=10\frac{9569}{10240}$, *Ans.*

DIVISION OF DECIMAL FRACTIONS.

¶ 99. 2. \$141‘00 ÷ \$‘75 $(\frac{141‘00}{‘75})$ = 188 bushels, *Ans.*
3. \$37‘000 ÷ \$‘125 $(\frac{37‘000}{‘125})$ = 296 pounds, *Ans.*
4. \$8‘0000 ÷ \$‘00625 $(\frac{8‘0000}{‘0065})$ = 128 oranges, *Ans.*
5. \$5‘000 ÷ ‘6 = \$8‘333 +, *Ans.*
6. \$468‘75 ÷ 750 $(\frac{468‘75}{750})$ = \$0,625, *Ans.*
7. \$181‘25 ÷ 125 $(\frac{181‘25}{125})$ = \$1‘45, *Ans.*
8. \$1913‘52 ÷ 536 $(\frac{1913‘52}{536})$ = \$3‘57, *Ans.*
9. \$3213 ÷ 84 $(\frac{3213}{84})$ = \$38‘25, *Ans.*

¶ 100. Review of Decimal Fractions.

EXERCISES.

2. $(7\frac{3}{10}=)$ 7‘3 yds. + $(12\frac{5}{8}=)$ 12‘625 yds. = 19‘925 yds.; then, $(36\frac{5}{8}=)$ 36‘625 yds. — 19‘925 yds. = 16‘7 yds., *Ans.*

3. \$$33\frac{11}{13}$ = \$33‘8461 +, \$$14\frac{6}{15}$ = \$14‘40, \$$7\frac{5}{9}$ = \$7‘5555 +, \$$\frac{5}{6}$ = \$‘8333 +; then, \$33‘8461 + \$14‘40 + \$7‘5555 + \$‘8333 = \$56‘634 +, *Ans.*

4. \$‘125 × 37‘75 = \$4‘718$\frac{3}{4}$, *Ans.*
5. \$17‘37 × 11‘625 tons = \$201‘92$\frac{5}{8}$, *Ans.*
6. \$201‘92625 ÷ 11‘625 = \$17‘37, *Ans.*
7. \$9 ÷ ‘45 ton = \$20, *Ans.*
8. \$0‘4 × ‘25 gal. = \$‘1, *Ans.*
9. \$‘007 × 2300 = \$16‘10, *Ans.*
10. \$‘18 × 765‘5 = \$137‘79, *Ans.*

11. \$‘165 (price of 1 pound) × 42 (the number of pounds in a firkin) = \$6‘93, cost of 1 firkin, which × 23 (the number of firkins) = \$159‘39, cost of 23 firkins, *Ans.*

12. $$\left.\begin{array}{rlrr}129+&129\text{ lbs. at} & \$‘05= & \$12‘90\\ 123+&125\ \text{“}\ \ \text{“} & ‘045= & 11‘16\\ &163\ \text{“}\ \ \text{“} & ‘07= & 11‘41\end{array}\right\}\ \$35‘47,\ \textit{Ans.}$$

13. Dr.	25 lbs. clover seed, at $‘11,	$2‘75
	3 pecks herds grass seed,	2‘25
	1 barrel flour,	6‘50
	13 lbs. sugar, at $‘12½,	1‘62½
		$13‘12½
Cr.	3 Cheeses, 27 lbs. each, at $‘08½,	$6‘88½
	5 barrels cider, at $1‘25,	6‘25
		$13‘13½

balance for the farmer, *Ans.*

14. $71600 — $39876‘74 = $31723‘26, which ÷ 7 = $4531‘89 +, *Ans.*

15. $‘87 × 100 = $87‘00, which ÷ $‘25 = 348 pounds, *Ans.*

16. 126 pounds × 3 = 378 pounds; then, $‘125 × 378 = $47‘25, *Ans.*

17. $86‘75 × 650 = $56387‘50, *Ans.*

18. $‘0625 × 275 = $17‘1875, which ÷ $‘50 = 34‘375 bushels, *Ans.*

19. $9‘32 × 18 = $167‘76, which ÷ $4‘66 = 36 yards, *Ans.*

20. $3’75 × 16 = $60; $4‘50 × 21 = $94‘50; $5,12½ × 35 = $179‘37½; then, $60 + $94‘50 + $179‘37½ = $333‘87½, *Ans.*

REDUCTION OF COMPOUND NUMBERS.

¶ 105. EXAMPLES FOR PRACTICE.

3. 32£. 15s. = 655s., which + 8d. = 7868d. = 31472qrs., *Ans.*

4. *Reverse the foregoing process;* thus, 31472 qrs. = 7868d. = 655s. + 8d., and 655s. = 32£. + 15s., together making 32£. 15s. 8d., *Ans.* *So in the following examples.*

5. 7£. 14s. = 154s., which + 6d. = 1854d., and 1854d. + 1qr. = 7417qrs., *Ans.*

6. 7417qrs. = 1854d. + 1qr., 1854d. = 154s. + 6d., and 154s. = 7£. 14s., together making 7£. 14s. 6d, 1qr., *Ans.*

7. 91£. 11s. = 1831s., which + 3d. = 21975d., and 21975d. + 2qrs. = 87902qrs., *Ans.*

10. 9752d. = 812s. + 8d., and 812s. = 40£. 12s., together making 40£. 12s. 8d., *Ans.*

11. 1£. 18s. = 38s., which + 4d. = 460d., and 460d. + ½d. = 921 half pence, *Ans.*

12. 921 half pence = 460d. + ½d., 460d. = 38s. + 4d., and 38s. = 1£. 18s., together making 1£. 18s. 4½d., *Ans.*

¶ 106. EXAMPLES FOR PRACTICE.

3. 7 T. = 14000 lbs., which + 665 lbs. = 14665 lbs., *Ans.*

5. 12 T. 15 cwt. = 255 cwt., 255 cwt. + 1 qr. = 1021 qrs., 1021 qrs. + 19 lbs. = 28607 lbs., which + 6 oz. = 457718 oz., and 457718 oz. + 12 drs. = 7323500 drs., *Ans.*

6. 7323500 drs. = 457718 oz. + 12 drs., 457718 oz. = 28607 lbs. + 6 oz., 28607 lbs. = 1021 qrs. + 19 lbs., 1021 qrs. = 255 cwt. + 1 qr., and 255 cwt. = 12 T. 15 cwt., together making 12 T. 15 cwt. 1 qr. 19 lbs. 6 oz. 12 drs., *Ans.*

7. 5 T. 9 cwt. = 109 cwt., which = 436 qrs.; and 436 qrs. + 12 lbs. = 12220 lbs.; then, 12220 lbs. ÷ 26 (the number of lbs. in a package) = 470 packages, *Ans.*

¶ 107. EXAMPLES FOR PRACTICE.

3. 7 lbs. 11 oz. = 95 oz., which + 3 pwt. = 1903 pwt.; and 1903 pwt. + 9 grs. = 45681 grs., *Ans.*

6. 5605 grs. = 233 pwt. + 13 grs., and 233 pwt. = 11 oz. + 13 pwt., together making 11 oz. 13 pwt. 13 grs., *Ans.*

7. 28 lbs × 7000 = 196000 grs. Troy; 196000 grs. = 8166 pwt. 16 grs.; 8166 pwt. = 408 oz. 6 pwt., 408 oz. = 34 lbs.; whence, 34 lbs. 6 pwt. 16 grs., *Ans.*

8. 34 lbs. = 408 oz., which + 6 pwt. = 8166 pwt., and 8166 pwt. + 16 grs. = 196000 grs. Troy; then, 196000 grs. ÷ 7000 = 28 lbs. Avoirdupois weight, *Ans.*

¶ 108. EXAMPLES FOR PRACTICE.

1. 9 lbs. 8 ℥. = 116 ℥., 116 ℥ + 1 ʒ. = 929 ʒ., which + 2 ℈. = 2789 ℈., and 2789 ℈. + 19 grs. = 55799 grs., *Ans.*

2. 55799 grs. = 2789 ℈. 19 grs., 2789 ℈. = 929 ʒ. 2 ℈., 929 ʒ. = 116 ℥. 1 ʒ., and 116 ℥. = 9 ℔. 8 ℥.; whence, 9 ℔. 8 ℥. 1 ʒ. 2 ℈. 19 grs., *Ans.*

¶ 109. EXAMPLES FOR PRACTICE.

1. 360 deg. = 24900 mi. = 7968000 rds. = 131472000 ft. = 1577664000 in., *Ans.*

4. 30539520 in. = 2544960 ft. = 154240 rds. = 482 mi., *Ans.*

5. The circumference of the wheel being 16 ft. 6 in., (= 1 rod,) it will turn round as many times as there are rods in 40 miles. 40 mi. = 12800 rds.; whence, 12800 times, *Ans.*

7. 43 mi. = 13760 rds. = 227040 ft. = 2724480 in.; and 2 ft. 6 in. = 30 in.; then, 2724480 in. ÷ 30 in. = 90816 times = 90816 steps, *Ans.*

8. (2 ft. 6 in. =) 30 in. × 90816 = 2724480 in. = 227040 ft. = 13760 rds. = 43 mi., *Ans.*

¶ 110. EXAMPLES FOR PRACTICE.

1. 573 yds. 1 qr. = 2293 qrs., which + 1 na. = 9173 na., *Ans.*

4. 5932 na. = 1483 qrs. = 296 E. E. 3 qrs., *Ans.*

5. 151 E. E. = 755 qrs. = 188 yds. 3 qrs., *Ans.*

7. 36 E. Fl. × 29 = 1044 E. Fl. = 3132 qrs. = 783 yds., *Ans.*

¶ 111. EXAMPLES FOR PRACTICE.

1. 17 A. 3 R. = 71 R., which + 12 P. = 2852 P. = 776457 sq. ft., *Ans.*

2. 776457 sq. ft. = 2852 P. = 71 R. 12 P., and 71 R. = 17 A. 3 R.; whence, 17 A. 3 R. 12 P., *Ans.*

3. 64 M. = 40960 A. = 6553600 P. = 1784217600 sq. ft., *Ans.*

5. 6 × 6 = 36 M. = 23040 A., *Ans.*

7. 197663000 M. = 126504320000 A. = 20240691200000 P. = 5510528179200000 sq. ft., *Ans.*

¶ 112. EXAMPLES FOR PRACTICE.

1. 5 mi. 71 C. = 471 C., *Ans.*

3. 2 mi. 15 C. = 175 C., which + 3 rds. = 703 rds., and 703 rds. + 18 l. = 17593 l., *Ans.*

5. 75 C. = 4950 ft., *Ans.*

7. 8 A. 2 sq. C. = 82 sq. C., which + 7 P. = 1319 P., and 1319 P. + 456 sq. l. = 824831 sq. l., *Ans.*

9. 80 A. = 800 sq. C. = 8000000 sq. l., *Ans.*

¶ 113. EXAMPLES FOR PRACTICE.

1. 9 T. = 450 cu. ft. = 777600 cu. in., *Ans.*

3. 37 C. ft. = 592 cu. ft., *Ans.*

7. 16 C. = 128 C. ft. = 2048 cu. ft., *Ans.*

9. 25 C. 5 C. ft. = 205 C. ft., which + 9 cu. ft. = 3289 cu. ft., and 3289 cu. ft. + 1575 cu. in. = 5684967 cu. in., *Ans.*

¶ 114. EXAMPLES FOR PRACTICE.

1. 12 P. = 24 hhd. = 1512 gal. = 6048 qts. = 12096 pts., *Ans.*

3. 9 P. 1 hhd. = 19 hhd., 19 hhd. 22 gal. = 1219 gal., 1219 gal. 3 qts. = 4879 qts. = 9758 pts. = 39032 gi., *Ans.*

5. 25 tier. = 1050 gal. = 4200 qts. = 8400 pts. = 33600 gi., *Ans.*

Beer Measure.

¶ 115. EXAMPLES FOR PRACTICE.

1. 47 bar. 18 gal. = 1710 gal. = 6840 qts. = 13680 pts., *Ans.*

3. 29 hhds. = 1566 gal. = 6264 qts. = 12528 pts., *Ans.*

Dry Measure.

¶ 116. EXAMPLES FOR PRACTICE.

1. 75 bu. = 300 pks. = 2400 qts. = 4800 pts., *Ans.*

3. 42 ch. = 1512 bu. = 6048 pks., *Ans.*

5. 273 qrs. 6 bu. 2190 bu., 2190 bu. + 3 pks. = 8763 pks., which + 7 qts. = 70111 qts., and 70111 qts + 1 pt. = 140223 pts., *Ans.*

Time.

¶ 117. EXAMPLES FOR PRACTICE.

1. From Jan. 1st, 1790, to Jan. 1st, 1804, was 14 yrs. = 5112 d. + from Jan. 1st to March 1st, 1804, including the two days named, 61 d. = 5173 d. = 124152 h. = 7449120 m. = 446947200 s., *Ans.*

2. 447033600 s. = 7450560 m. = 124176 h. = 5174 d. = 739 wks. 1 d., *Ans.*

3. From July 4th, M., to Sept. 29th, 6 o'clock, P. M., is 87 d. 6 h. = 2094 h. = 125640 m., *Ans.*

4. 125640 m. = 2094 h. = 87 d. 6 h., which added to July 4th, M., gives the time to be Sept. 29th, 6 o'clock, P. M., *Ans.*

5. From 23 minutes past 4 o'clock, A. M., to 40 minutes past 7 o'clock, P. M., is 15 h. 17 m. = 917 m. = 55020 s., *Ans.*

6. 55020 s. = 917 m. = 15 h. 17 m., *Ans.*

7. From Apr. 19th, 1775, to Apr. 19th, 1782, was 7 yrs. = 2557 d. = 61368 h. = 3682080 mi.; and from Apr. 19th, 1782, to Jan. 20th, 1783, was 276 d. = 6624 h. = 397440 m.; then, 3682080 m. + 397440 m. = 4079520 m., *Ans.*

8. 4079520 m. = 67992 h. = 7 yrs. 276 d. 6 h., estimating 365 d. 6 h. as a year, or 7 yrs. 278 d., estimating 365 d. as a year, *Ans.*

¶ 118. EXAMPLES FOR PRACTICE.

1. 9 s. 13° = 283°; 283° 25′ = 17005′ = 1020300″, *Ans.*
3. 3 s. = 90° = 5400′, *Ans.*

Reduction of Fractional Compound Numbers.

¶ 120. EXAMPLES FOR PRACTICE.

NOTE. In performing the examples in this ¶, it will generally be found more expeditious, to write each given fraction, and all the multipliers or divisors necessary to perform the required reduction, either as one compound fraction, or as several fractions to be multiplied together; the operations then may frequently be contracted by cancelation. See ¶¶ 40 and 86.

3. $\frac{3}{\underset{\underset{19}{\cancel{38}}}{\cancel{760}}}$ lb. Troy $\times \frac{\overset{6}{\cancel{12}}}{1} \times \frac{\cancel{20}}{1} \times \frac{24}{1} = \frac{432}{19}$ gr., *Ans.*

4. $\frac{\overset{\overset{3}{\cancel{18}}}{\cancel{432}}}{19}$ gr. $\times \frac{1}{\cancel{24}} \times \frac{1}{20} \times \frac{1}{\underset{2}{\cancel{12}}} = \frac{3}{760}$ lb., *Ans.*

5. $\frac{1}{\underset{685}{\cancel{2740}}}$ hhd. $\times \frac{54}{1} \times \frac{\cancel{4}}{1} \times \frac{2}{1} = \frac{108}{685}$ pt., *Ans.*

6. $\frac{\overset{\cancel{54}}{\cancel{108}}}{685}$ pt. $\times \frac{1}{\cancel{2}} \times \frac{1}{4} \times \frac{1}{\cancel{54}} = \frac{1}{2740}$ hhd., *Ans.*

7. $\frac{\overset{4}{\cancel{8}}}{\underset{5}{\cancel{45}}}$ hhd. $\times \frac{\overset{\cancel{6}}{\cancel{54}}}{1} \times \frac{1}{\underset{\underset{3}{\cancel{6}}}{\cancel{36}}} = \frac{4}{15}$ bar., *Ans.*

8. $(\frac{8}{30}=)\ \frac{4}{15}$ bar. $\times \frac{\overset{2}{\cancel{36}}}{1} \times \frac{1}{\underset{3}{\cancel{54}}} = \frac{8}{45}$ hhd., *Ans.*

9. $\frac{2}{\underset{355}{\cancel{22365}}}$ T. $\times \frac{2}{1} \times \frac{2}{1} \times \frac{\cancel{63}}{1} \times \frac{4}{1} \times \frac{2}{1} \times \frac{4}{1} = \frac{256}{355}$ gi., *Ans.*

10. $(\frac{16128}{22365}=)\ \frac{\begin{array}{c}2\\ \cancel{4}\\ \cancel{8}\\ \cancel{32}\\ \cancel{64}\\ \cancel{256}\end{array}}{355}$ gi. $\times \frac{1}{\cancel{4}} \times \frac{1}{\cancel{2}} \times \frac{1}{\cancel{4}} \times \frac{1}{63} \times \frac{1}{\cancel{2}} \times \frac{1}{\cancel{2}} =$ $\frac{2}{22365}$ T., *Ans.*

11. $\frac{1}{\begin{array}{c}\cancel{100000000}|00\\ \cancel{1562500}\\ 390625\end{array}}$ M. $\times \frac{\cancel{64}|0}{1} \times \frac{\cancel{4}}{1} \times \frac{\cancel{4}|0}{1} \times (272\frac{1}{4}=)\ \frac{1089}{\cancel{4}}$ $\times \frac{144}{1} = \frac{156816}{390625}$ sq. in., *Ans.*

Note. Cutting off the ciphers from 640 and 40 in the numerators, and two ciphers from the first denominator, in the above operation, divides the numerator and denominator of the product by 100.

12. $(\frac{4014489600}{10000000000}=)\ \frac{\overset{\cancel{1089}}{\cancel{156816}}}{390625}$ sq. in. $\times \frac{1}{\cancel{144}} \times (\frac{1}{272\frac{1}{4}}=)$ $\frac{\cancel{4}}{\cancel{1089}} \times \frac{1}{40} \times \frac{1}{\cancel{4}} \times \frac{1}{640} = \frac{1}{10000000000}$ M., *Ans.*

13. $\frac{5}{\begin{array}{c}\cancel{2688}\\ \cancel{672}\\ \cancel{84}\\ 42\end{array}}$ bu. $\times \frac{\cancel{4}}{1} \times \frac{\cancel{8}}{1} \times \frac{\cancel{2}}{1} = \frac{5}{42}$ pt., *Ans.*

14. $\frac{5}{42}$ pt. $\times \frac{1}{2} \times \frac{1}{8} \times \frac{1}{4} = \frac{5}{2688}$ bu., *Ans.*

15. $\frac{11}{\underset{1440}{\cancel{10080}}}$ w. $\times \frac{\cancel{7}}{1} \times \frac{24}{1} = \frac{11}{60}$ h., *Ans.*

16. $\frac{11}{60}$ h. $\times \frac{1}{24} \times \frac{1}{7} = \frac{11}{10080}$ w., *Ans.*

17. $\frac{1}{\underset{\underset{3}{\cancel{99}}}{\cancel{396}|0}}$ mi. $\times \frac{\overset{\overset{4}{\cancel{8}}}{\cancel{32}|0}}{1} \times (16\frac{1}{2}=) \frac{\cancel{33}}{\cancel{2}} = \frac{1}{3}$ ft., *Ans.*

18. $\frac{\cancel{4}}{3}$ ft. $\times (\frac{1}{16\frac{1}{2}}=) \frac{\cancel{2}}{33} \times \frac{1}{\underset{\underset{40}{\cancel{80}}}{\cancel{320}}} = \frac{1}{3960}$ mi., *Ans.*

19. $\frac{\cancel{2}}{9}$ of $\frac{1}{\underset{3}{\cancel{6}}}$£. $\times \frac{20}{1} = \frac{20}{27}$ s., *Ans.*

20. $\frac{\cancel{20}}{27}$s. $\times \frac{1}{\cancel{20}} = \frac{1}{27}$£. Since $\frac{1}{27}$£. is $\frac{2}{9}$ of the required fraction, $\frac{1}{2}$ of $\frac{1}{27} = \frac{1}{54}$ is $\frac{1}{9}$, which $\times\ 9 = (\frac{1}{\underset{6}{\cancel{54}}} \times \frac{\cancel{9}}{1} =) \frac{1}{6}$, the required fraction, *Ans.*

21. $\frac{1}{\underset{\cancel{4}}{\cancel{8}}}$ of $\frac{\cancel{2}}{11}$ of $\frac{3}{1}$£. $\times \frac{\overset{5}{\cancel{20}}}{1} \times \frac{12}{1} = \frac{180}{11}$d., *Ans.*

22. 1*st question.* $\frac{\overset{\overset{3}{\cancel{15}}}{\cancel{180}}}{11}$d. $\times \frac{1}{\cancel{12}} \times \frac{1}{\underset{4}{\cancel{20}}} = \frac{3}{44}$ of 1£., whicb $\div 3 = \frac{1}{44}$ of 3£. Since $\frac{1}{44}$ of 3£. is $\frac{1}{8}$ of the required frac 8 times $\frac{1}{44} = (\frac{1}{\underset{11}{\cancel{44}}} \times \frac{\overset{2}{\cancel{8}}}{1} =) \frac{2}{11}$ of 3£., is the required fraction, *Ans.*

2d. *question.* $\frac{\overset{\overset{3}{\cancel{15}}}{\cancel{180}}}{11}$d. $\times \frac{1}{\cancel{12}} \times \frac{1}{\underset{4}{\cancel{20}}} = \frac{3}{44}$ of 1£., which $\div 3 = \frac{1}{44}$ of 3£. Since $\frac{1}{44}$ of 3£. is $\frac{2}{11}$ of the required fraction,

$\frac{1}{2}$ of $\frac{1}{44}=\frac{1}{88}$ is $\frac{1}{11}$, which $\times$ 11 $=(\frac{1}{\underset{8}{\cancel{88}}}\times\frac{\cancel{11}}{1}=)$ $\frac{1}{8}$ of 3£. is the required part, *Ans.*

3*d.* *question.* $\frac{\overset{\overset{3}{\cancel{15}}}{\cancel{180}}}{11}$d. $\times\frac{1}{\cancel{12}}\times\frac{1}{\underset{4}{\cancel{20}}}=\frac{3}{44}$ of 1£. Since $\frac{3}{44}$£. is $\frac{1}{\underset{4}{\cancel{8}}}$ of $\frac{\cancel{2}}{11}=\frac{1}{44}$ of the required number of pounds, 44 times $\frac{3}{44}$£. $=(\frac{3}{\cancel{44}}$£. $\times\frac{\cancel{44}}{1}=)$ 3£. is the required number of pounds, *Ans.*

¶ 121. EXAMPLES FOR PRACTICE.

5. $\frac{3}{5}$ lb. $=\frac{36}{5}$ oz. $=7\frac{1}{5}$ oz., $\frac{1}{5}$ oz. $=\frac{20}{5}$ pwt. $=4$ pwt. *Ans.*, 7 oz. 4 pwt.

6. 7 oz. 4 pwt. $=144$ pwt., the numerator; 1 lb. $=12$ oz. $=240$ pwt., the denominator; then, $\frac{144}{240}$ lb. $=\frac{3}{5}$ lb., *Ans.*

7. $\frac{5}{9}$ lb. $=\frac{80}{9}$ oz. $=8\frac{8}{9}$ oz., $\frac{8}{9}$ oz. $=\frac{128}{9}$ dr. $=14\frac{2}{9}$ dr. *Ans.*, 8 oz. $14\frac{2}{9}$ dr.

8. 8 oz. $14\frac{2}{9}$ dr. $=142\frac{2}{9}$ dr. $=\frac{1280}{9}$ dr.; 1 lb. $=16$ oz. $=256$ dr. $=\frac{2304}{9}$ dr.; then, $\frac{1280}{2304}$ lb. $=\frac{5}{9}$ lb., *Ans.*

9. $\frac{4}{7}$ mi. $=4\frac{4}{7}$ fur., $\frac{4}{7}$ fur. $=125\frac{5}{7}$ yds., $\frac{5}{7}$ yd. $=2\frac{1}{7}$ ft., $\frac{1}{7}$ ft. $=1\frac{5}{7}$ in., and $\frac{5}{7}$ in. $=2\frac{1}{7}$ bar. *Ans.*, 4 fur. 125 yds. 2 ft. 1 in. $2\frac{1}{7}$ bar.

10. 4 fur. 125 yds. $=1005$ yds., 1005 yds. 2 ft. $=3017$ ft., 3017 ft. 1 in. $=36205$ in., 36205 in. $2\frac{1}{7}$ bar. $=108617\frac{1}{7}$ bar. $=\frac{760320}{7}$ bar.; 1 mi. $=\frac{1330560}{7}$ bar.; then, $\frac{760320}{1330560}$ mi. $=\frac{4}{7}$ mi., *Ans.*

11. $\frac{4}{5}$ w. $=5\frac{3}{5}$ d., $\frac{3}{5}$ d. $=14\frac{2}{5}$ h., and $\frac{2}{5}$ h. $=24$ m. *Ans.*, 5 d. 14 h. 24 m.

12. 5 d. 14 h. 24 m. $=8064$ m.; 1 w. $=10080$ m.; then, $\frac{8064}{10080}$ w. $=\frac{4}{5}$ w., *Ans.*

13. $\frac{7}{16}$ A. $=1\frac{3}{4}$ R., and $\frac{3}{4}$ R. $=30$ P. *Ans.*, 1 R. 30 P.

14. 1 R. 30 P. $=70$ P.; 1 A. $=160$ P.; then, $\frac{70}{160}$ A. $=\frac{7}{16}$ A., *Ans.*

15. $\frac{9}{10}$ yd. $=2\frac{7}{10}$ ft., $\frac{7}{10}$ ft. $=8\frac{2}{5}$ in., and $\frac{2}{5}$ in. $=1\frac{1}{5}$ bar. *Ans.*, 2 ft. 8 in. $1\frac{1}{5}$ bar.

16. 2 ft. 8 in. $1\frac{1}{5}$ bar. $=\frac{486}{5}$ bar.; 1 yd. $=\frac{540}{5}$ bar.; then, $\frac{486}{540}$ yds. $=\frac{9}{10}$ yd., *Ans.*

17. 3 R. 17$\frac{1}{2}$ P. = $\frac{275}{2}$ P.; 1 A. = $\frac{320}{2}$ P.; then, $\frac{275}{320}$ A. $\frac{55}{64}$ A., *Ans.*

18. 27 gal. 3 qts. 1 pt. = 223 pts.; 1 hhd. = 504 pts.; then, $\frac{223}{504}$ hhd., *Ans.*

19. $\frac{5}{13}$ of $\frac{7}{1}$ cwt. = $\frac{35}{13}$ cwt. = 2$\frac{9}{13}$ cwt., $\frac{9}{13}$ cwt. = 2$\frac{10}{13}$ qrs., $\frac{10}{13}$ qrs. = 21$\frac{7}{13}$ lbs., and $\frac{7}{13}$ lb. 8$\frac{8}{13}$ oz. *Ans.*, 2 cwt. 2 qrs. 21 lbs. 8$\frac{8}{13}$ oz.

The foregoing reversed. 2 cwt. 2 qrs. 21 lbs. 8$\frac{8}{13}$ oz. is $\frac{5}{13}$ of how many cwt.? 2 cwt. 2 qrs. 21 lbs. 8$\frac{8}{13}$ oz. = $\frac{62720}{13}$ oz.; 1 cwt. = $\frac{23296}{13}$ oz.; then, $\frac{62720}{23296}$ cwt. ÷ $\frac{5}{13}$ = ($\frac{62720}{23296}$ × $\frac{13}{5}$ =) $\frac{7}{1}$ cwt. = 7 cwt., that is, $\frac{5}{13}$ of 7 cwt., *Ans.*

20. 13 h. 42 m. 51$\frac{3}{7}$ s. = $\frac{345600}{7}$ s.; 1 d. = $\frac{604800}{7}$ s.; then, $\frac{\text{[illegible]}5600}{\text{[illegible]}04800}$ d. = $\frac{4}{7}$ d., *Ans.*

Reduction of Decimal Compound Numbers.

¶ 122. EXAMPLES FOR PRACTICE.

3. ‘213 T. = 4‘26 cwt., ‘26 cwt. 1‘04 qr., ‘04 qr. = 1‘12 lb., ‘12 lb. = 1‘92 oz., and ‘92 oz. = 14‘72 dr. *Ans.*, 4 cwt. 1 qr. 1 lb. 1 oz. 14‘72 drs.

4. 1 oz. 14‘72 drs. = 1‘92 oz., 1 lb. 1‘92 oz. = 1‘12 lb., 1 qr. 1‘12 lb. = 1‘04 qr., and 4 cwt. 1‘04 qr. = 4‘26 cwt. = ‘213 T., *Ans.*

5. 6 ℔. = 7‘2 ℥., ‘2 ℥. = 1‘6 ʒ., ‘6 ʒ. = 1‘8 ℈, and ‘8 ℈ = 16 grs. *Ans.*, 7 ℥. 1 ʒ. 1 ℈. 16 grs.

6. 16 grs. = ‘8 ℈., 1‘8 ℈. = ‘6 ʒ., 1‘6 ʒ. = ‘2 ℥., and 7‘2 ℥. = ‘6 ℔., *Ans.*

7. ‘76754 M. = 491‘2256 A., ‘2256 A. = 36‘096 P., ‘096 P. = 26‘136 sq. ft., and ‘136 sq. ft. = 19‘584 sq. in. *Ans.*, 491 A. 36 P. 26 sq. ft. 19‘584 sq. in.

8. 19‘584 sq. in. = ‘136 sq. ft., 26‘136 sq. ft. = ‘096 P., 36‘096 P. = ‘2256 A., and 491‘2256 A. = ‘76754 M., *Ans.*

9. ‘3958 bar. = 12‘4677 gal., ‘4677 gal. = 1‘8708 qt., ‘8708 qt. = 1‘7416 pt., and ‘7416 pt. = 2‘9664 gi. *Ans.*, 12 gal. 1 qt. 1 pt. 2‘9664 gi.

10. 2‘9664 gi. = ‘7416 pt., 1‘7416 pt. = ‘8708 qt., 1‘8708 qt. = ‘4677 gal., and 12‘4677 gal. = ‘3958 bar. of wine, *Ans.*

11. ‘73 C. = 5‘84 C. ft., 84 C. ft. = 13‘44 cu. ft., and ‘44 cu. ft. = 760‘32 cu. in. *Ans.*, 5 C. ft. 13 cu. ft. 760‘32 cu. in.

12. 760‘32 cu. in. = ‘44 cu. ft., 13‘44 cu. ft. = ‘84 C. ft., and 5‘84 C. ft. = ‘73 C., *Ans.*

13. ‘648 qr. = 5‘184 bu., ‘184 bu. = 5‘888 qts., and ‘888 qts. = 1‘776 pts. *Ans.*, 5 bu. 5 qts. 1‘776 pts.

14. 1‘776 pts. = ‘888 qt., 5‘888 qts. = ‘184 bu., and 5‘184 bu. = ‘648 qr., *Ans.*

15. ‘125 lb. Troy = 1‘5 oz., and ‘5 oz. = 10 pwt. *Ans.*, 1 oz. 10 pwt.

16. 10 pwt. = ‘5 oz., and 1‘5 oz. = ‘125 lb. Troy, *Ans.*

17. ‘72 hhd. = 38‘88 gal., and ‘88 gal. = 3‘52 qts. *Ans.*, 38 gal. 3‘52 qts.

18. 3‘52 qts. = ‘88 gal., and 38‘88 gal. = ‘72 hhd., *Ans.*

19. ‘375 yd. = 1‘5 qrs., and ‘5 qr. = 2 na. *Ans.*, 1 qr. 2 na.

20. 2 na. = ‘5 qr., and 1‘5 qrs. = ‘375 yd., *Ans.*

21. ‘713 d. = 17‘112 h., ‘112 h. = 6‘72 m., and ‘72 m. = 43‘2 s. = $43\frac{1}{5}$ s. *Ans.*, 17 h. 6 m. $43\frac{1}{5}$ s.

22. $43\frac{1}{5}$ s. = 43‘2 s. = ‘72 m., 6‘72 m. = ‘112 h., and 17‘112 h. = ‘713 d., *Ans.*

23. 4 P. = ‘025 A., *Ans.* *Reversed*, ‘025 A. = 4 P.

24. ‘7 lb. Troy = 8‘4 oz., and ‘4 oz. = 8 pwt. *Ans.*, 8 oz. 8 pwt.

25. 50‘4 s. = ‘84 m., 15‘84 m. = ‘264 h., and 18‘264 h. = ‘761 d., *Ans.*

26. 2 ft. = ‘6̇ yd., 3‘6̇ yds. = ‘6̇ rd., 2‘6̇ rds. = ‘06̇ fur., 6‘06̇ fur. = ‘7583̇ mi., and 11‘7583̇ mi. = ‘169̇ deg., *Ans.*

¶ 123. Review of Reduction of Compound Numbers.

EXERCISES.

1. 46£. 4s. = 924s., which × $24\frac{1}{5}$ (the number of cents in 1s.) = $223‘608.

2. 3 lb. 5 oz. 16 pwt. 2 grs. = 20066 grs.; 5 pwt. 7 grs. = 127 grs.; then, 20066 grs. ÷ 127 grs. = 158 times = 158 rings, *Ans.*

3. 212 rds. = 41976 in.; and 18 ft. 6 in. = 222 in.; then, 41976 in. ÷ 222 in. = $189\frac{3}{37}$ times, *Ans.*

4. 10 lbs. = 2400 pwt.; 5 oz. 10 pwt. = 110 pwt.; then, 2400 pwt. ÷ 110 pwt. = $21\frac{9}{11}$ times = $21\frac{9}{11}$ spoons, *Ans.*

5. 6 sq. in. × 4 (4 rows of 6 squares each) = 24 sq. in. covered by 1 shingle, and 144 sq. in. (= 1 sq. ft.) ÷ 24 sq. in. (= 1 shingle) = 6 shingles to cover 1 sq. ft: 40 ft. × 24 ft. (length × breadth) = 960 sq. ft., (the area of the roof,)

which × 6 (the number of shingles on 1 sq. ft.) = 5760 shingles, *Ans.*

6. 26 ft. (long) × 4 ft. (wide) × 6 ft. (high) = 624 cu. ft. = 39 C. ft. = 4 C. 7 C. ft., *Ans.*

7. 18 + 18 + 16 + 16 = 68 ft. (length of all the walls,) which × 8 = 544 sq. ft. (to be covered;) (11 yds. =) 33 ft. × 2 ft. = 66 sq. ft. (in 1 piece of paper;) then, 544 sq. ft. ÷ 66 sq. ft. = $8\frac{8}{33}$ times = $8\frac{8}{33}$ rolls, *Ans.*

8. $6\frac{1}{2}$ ft. × 2 ft. × 5 ft. = 65 cu. ft. = $4\frac{1}{16}$ C. ft., *Ans.*

9. 3 w. 4 d. 16 h. = 616 h., and 7 mi. × 616 = 4312 mi., *Ans.*

10. $2‘75 × 63 (gal. = 1 hhd.) = $173‘25, cost of 1 hhd.; and $173‘25 × 12 = $2079, cost of 12 hhds., *Ans.*

11. 10£. 8s. = 2496d., and 5s. 4d. = 64 d.; then, 2496d. ÷ 64d. = 39 times = 39 oz. = 3 lbs. 3 oz., *Ans.*

12. 2 lbs. 8 oz. 16 pwt. = 656 pwt.; 3d. × 656 = 1968d. = 8£. 4s., *Ans.*

13. 9 qts. × 365 = 3285 qts. = 15 hhds. 11 gal. 1 qt., *Ans.*

14. 14445 E. Fl. = 43335 qrs. = 8667 E. E., *Ans.*

15. $44\frac{1}{2}$ × 3 = $133\frac{1}{2}$ shingles to lay one course; 20 ft. × 3 = 60 courses on one side; $133\frac{1}{2}$ × 60 = 8010 shingles to cover one side; 8010 × 2 = 16020 shingles to cover both sides, *Ans.*

16. $54\frac{1}{2}$ mi. = 3453120 in., which ÷ 30 in. = 115104 times = 115104 steps, *Ans.*

17. 40 yrs. = 14610 d. Since he redeems $\frac{1}{2}$ hour (= 30 minutes) in 1 day, in 14610 days he would redeem $14610\frac{1}{2}$ hours = 438300 m. = 26298000 s., *Ans.*

18. 45 yrs. = 16436 days, which — 2348 (Sundays) = 14088 working days; 4s. × 14088 = 56352 s., which × $24\frac{1}{5}$ = $13637‘184, *Ans.*

19. 9 candles × 24 = 216 candles, which ÷ 12 = 18 doz., *Ans.*

20. 4 lbs. 6 oz. = 70 oz. Since 16 oz. make 60 knots, 1 oz. will make $\frac{1}{16}$ of 60 knots = $\frac{60}{16}$ = $3\frac{3}{4}$ knots, and 70 oz will make 70 times $3\frac{3}{4}$ knots = $262\frac{1}{2}$ knots = $26\frac{1}{4}$ skeins, *Ans.*

21. From the commencement of the Christian era till 12 o'clock at noon of Dec. 10th, 1847, would be 1846 years 343 days 12 hours, if the calendar had not been altered. But in Sept., 1752, 10 days were rejected from the calendar; hence, the exact time must be 1846 years 333 days 12 hours. In 1846 years are 457 leap years. Then. 1846 yrs. 333 d. =

674580 d., which, + 12 h. = 16189932 h., and 16189932 h. = $96368\frac{9}{14}$ w, *Ans.*

22. (Consult ¶ 120, Note.) $\frac{7}{\underset{\underset{8}{160}}{\cancel{1920}}}$ lb. Troy $\times \frac{\cancel{12}}{1} \times \frac{\cancel{20}}{1} =$ $\frac{7}{8}$ pwts., *Ans.*

23. $\frac{\cancel{3}}{4}$ qr. $\times \frac{1}{4} \times \frac{1}{\underset{4}{\cancel{12}}} \times \frac{1}{20} = \frac{1}{1280}$£., *Ans.*

24. 4 qrs. $1\frac{1}{2}$ na. = $17\frac{1}{2}$ na. = $\frac{35}{2}$ na.; 1 E. E. = 20 na. = $\frac{40}{2}$ na.; then, $\frac{35}{40}$ E. E. = $\frac{7}{8}$ E. E., *Ans.*

25. 2 qrs. $2\frac{2}{3}$ na. = $10\frac{2}{3}$ na. = $\frac{32}{3}$ na.; 1 yd. = $\frac{48}{3}$ na.; then, $\frac{32}{48}$ yd. = $\frac{2}{3}$ yd., *Ans.*

26. 16 h. 36 m. $55\frac{5}{13}$ s. = $\frac{777600}{13}$ s.; 1 d. = $\frac{1123200}{13}$ s.; then, $\frac{7776}{11232}$ d. = $\frac{9}{13}$ d., *Ans.*

27. 6 fur. 26 r. 11 ft. = 4400 ft.; 1 mi. = 5280 ft.; then, $\frac{440}{528}$ mi. = $\frac{5}{6}$ mi., *Ans.*

28. $\frac{3}{13}$ T. = $4\frac{8}{13}$ cwt., $\frac{8}{13}$ cwt. = $2\frac{6}{13}$ qrs., $\frac{6}{13}$ qr. = $12\frac{12}{13}$ lbs., $\frac{12}{13}$ lb. = $14\frac{10}{13}$ oz., and $\frac{10}{13}$ oz. = $12\frac{4}{13}$ drs. *Ans.*, 4 cwt. 2 qrs. 12 lbs. 14 oz. $12\frac{4}{13}$ drs.

29. 37 s. = $61\dot{6}$ m., $55‘61\dot{6}$ m. = $‘9269\dot{4}$ h. = $‘03862268\dot{5}\dot{1}$ d., *Ans.*

30. 9 grs. = ‘375 pwt., 13‘375 pwt. = ‘66875 oz., and 10‘66875 oz. = ‘8890625 lb., *Ans.*

31. ‘397 yd. = 1‘588 qrs., and ‘588 qr. = 2‘352 na. *Ans.*, 1 qr. 2‘352 na.

Addition of Compound Numbers.

¶ 124. EXAMPLES FOR PRACTICE.

7. 11 s. + 18 s. + 5 s. = 34 s., 55 m. + 42 m. + 18 m. = 1 h. 55 m., 1 h. + 23 h. + 16 h. + 5 h. = 1 d. 21 h., 1 d. + 6 d. + 5 d. = 1 w. 5 d., 1 w. + 47 w. + 38 w. + 24 w. = 110 w. = 2 yrs. 5 w. 4 d. 12 h. 22 m. 24 s., and 2 yrs. + 57 yrs. + 84 yrs. + 32 yrs. = 175 yrs.; then, 175 yrs. 0 w. 5 d. 21 h. 55 m. 34 s. + 5 w. 4 d. 12 h. 22 m. 24 s. = 175 yrs. 6 w. 3 d. 10 h. 17 m. 58 s., *Ans.*

NOTE. The above conforms to the example as presented in the 1st edition of the Arithmetic. To simplify the operation, in later editions, the sum of the weeks will be found to be *less* than one year.

8. 10 drs. + 15 drs. + 9 drs. = 2 oz. 2 drs., 2 oz. + 5 oz. + 9 oz. + 11 oz. = 1 lb. 11 oz., 1 lb. + 16 lbs. + 11 lbs. + 25 lbs. = 1 qr. 25 lbs., 1 qr. + 1 qr. + 2 qrs. = 1 cwt., which +

11 cwt. + 18 cwt. = 1 T. 10 cwt., and 1 T. + 14 T. + 25 T. + 7 T. = 47 T. *Ans.*, 47 T. 10 cwt. 25 lbs. 11 oz. 2 drs.

11. (9576 lbs. =) 4 T. 1576 lbs. + 11 T. + (7 T. 18 cwt. 27 lbs. = 17723 lbs. =) 8 T. 1723 lbs. = 24 T. 1299 lbs., *Ans.*

26. 3° 8′ 45″ + 2° 36′ + 4° 52″ + 1° 48′ 52″ + 1° 19′ + 59′ 30″ = 13° 52′ 59″ South. 1° 51′ + 2° 1′ 15″ + 1° + 3° 16′ 22″ + 48′ 29″ + 3° 52′ 11″ = 12° 49′ 17″ East, *Ans.*

27. 116 sq. yds. 7 sq. ft. 96 sq in. + 116 sq. yds. 7 sq. ft. 96 sq. in. + 178 sq. yds. 138 sq. in. + 178 sq. yds. 138 sq. in. + 439 sq. yds. 6 sq. ft. 78 sq. in. = 1029 sq. yds. 5 sq. ft. 114 sq. in., *Ans.*

29. 4 bar. 176 lbs. 8 oz. + 18 bar. (40½ lbs. =) 40 lbs. 8 oz. + 1 bar. 104 lbs. 7 oz. + (181¾ bar. =) 181 bar. 147 lbs. = 206 bar. 76 lbs. 7 oz., *Ans.*

30. (2¼ bu. =) 2 bu. 15 lbs. + 2 bu. 21 lbs. 7 oz. + (1½ bu. 18 lbs. =) 1 bu. 48 lbs. + 2 bu. 50 lbs. + 1 bu. (58¾ lbs. =) 58 lbs. 12 oz. = 11 bu. 13 lbs. 3 oz., *Ans.*

31. 35 bar. 27 gal. 3 qts. + 19 bar. 5 gal. 1 qt. + 7 bar. 13 gal. 3 qts. = 62 bar. 14½ gal. 3 qts. = 62 bar. 15 gal. 1 qt., *Ans.*

32. 12 rds. 9 ft. 4 in. + 15 rds. 7 ft. 8 in. + 6 rds. 4 ft. 5 in. = 34 rds. 4½ ft. 5 in. = 34 rds. 4 ft. 11 in., *Ans.*

33. 59 deg. 46 mi. 6 fur. 39 rds. 15 ft. 10 in. + 216 deg. 39 mi. 7 fur. 39 rds. 4 ft. 7 in. + 78 deg. 53 mi. 7 fur. 38 rds. 9 ft. 8 in. = 355 deg. 1¾ mi. 6 fur. 37 rds. 13½ ft. 1 in. = 355 deg. 2 mi. 4 fur. 11 rds. 2½ ft. 1 in. = 355 deg. 2 mi. 4 fur. 11 rds. 2 ft. 7 in., *Ans.*

34. 2 A. 75 P. 248 sq. ft. 72 sq. in. + 3 A. 120 P. 177 sq. ft. 85 sq. in. + 15 A. 17 P. 84 sq. ft. 80 sq. in. = 21 A. 53 P. 237¾ sq. ft. 93 sq. in. = 21 A. 53 P. 238 sq. ft. 57 sq. in., *Ans.*

35. 25 gr. gr. 9 gr. 7 doz. 11 + 15 gr. gr. 7 gr. 8 doz. + 40 gr. gr. 4 doz. = 81 gr. gr. 5 gr. 7 doz. 11 screws, *Ans.*

ADDITION OF FRACTIONAL COMPOUND NUMBERS.

¶ 125. 2. ⅞£. = 17s. 6d.; ¾s. = 9d.; and 17s. 6d. + 9d. = 18s. 3d., *Ans.*

3. ⅚ gal. = 3 qts. ⅔ pt., which + ¾ pt. = 3 qts. 1$\frac{5}{12}$ pts., *Ans.*

4. ½ lb. Troy = 6 oz.; $\frac{7}{12}$ oz. = 11 pwt. 16 grs.; and 6 oz 11 pwt. 16 grs. = 6 oz. 11 pwt. 16 grs., *Ans*

5. $\frac{3}{5}$ mi. = 192 rds.; $\frac{3}{11}$ rd. = 4 ft. 6 in.; and 192 rds. + 47 rds. 4 ft. 6 in. = 239 rds. 4 ft. 6 in., *Ans.*

6. $\frac{3}{8}$ of ($20\frac{1}{2}$ =) $\frac{41}{2}$ yds. = $\frac{123}{16}$ yds. = $7\frac{11}{16}$ yds. = 7 yds. 2 qrs. 3 na.; $\frac{5}{6}$ of ($9\frac{1}{4}$ =) $\frac{37}{4}$ yds. = $\frac{185}{24}$ yds. = $7\frac{17}{24}$ yds. = 7 yds. 2 qrs. $3\frac{1}{3}$ na.; and 7 yds. 2 qrs. 3 na. + 7 yds. 2 qrs. $3\frac{1}{3}$ na. = 15 yds. 1 qr. $2\frac{1}{3}$ na., *Ans.*

Subtraction of Compound Numbers.

¶ 126. EXAMPLES FOR PRACTICE.

7. 136£. 7s. 6d. 2qrs. — 50£. 10s. 4d. 3qrs. = 85£. 17s. 1d. 3 qrs., *Ans.*

8. 1256£. 10s. — 87£. 10s. 6d. = 1168£. 19s. 6d., *Ans.*

9. 118 gal. — 97 gal. 3 qts. 1 pt. = 20 gal. 0 qt. 1 pt. *Ans.*

10. 3 lb. 4 oz. — 5 oz. 7 pwt. 13 grs. = 2 lb. 10 oz. 12 pwt. 11 grs., *Ans.*

11. 256 A. 1 R. 10 P. — 87 A. 6 P. 10 sq. yds. = 169 A. 1 R. 3 P. 20 sq. yds. 2 sq. ft. 36 sq. in., *Ans.*

12. 15 lb. 2 oz. 5 pwt. — 9 oz. 8 pwt. 10 grs. = 14 lb. 4 oz. 16 pwt. 14 grs., *Ans.*

13. 10 yds. 3 qrs. 2 na. + 18 yds. 3 qrs. 3 na. = 29 yds. 3 qrs. 1 na.; then, 36 yds. 2 qrs. — 29 yds. 3 qrs. 1 na. = 6 yds. 2 qrs. 3 na., *Ans.*

14. 13 A. 3 R. + 14 A. 3 R. = 28 A. 2 R.; 26 A. 2 R. 27 P. + 45 A. 2 R. 33 P. = 72 A. 1 R. 20 P.; then, 72 A. 1 R. 20 P. — 28 A. 2 R. = 43 A. 3 R. 20 P., *Ans.*

17. 19 P. 55 sq. ft. 126 sq. in. — 7 P. 92 sq. ft. 11 sq. in. = 11 P. $235\frac{1}{4}$ sq. ft. 115 sq. in. = 11 P. 236 sq. ft. 7 sq. in., *Ans.*

18. 64 A. 2 R. 11 P. 29 sq. ft. — 26 A. 7 R. 34 P. 132 sq. ft. = 36 A. 2 R. 16 P. 169 sq. ft. 36 sq. in., *Ans.*

NOTE. In subtracting 7 R. from 1 R., we must borrow 2 A. from 64 A.

19. (9 rds. 5 yds. 2 ft. 11 in. =) 10 rds. 0 yd. 1 ft. 5 in. — 10 rds. 0 yd. 1 ft. 2 in. = 3 in., *Ans.*

20. (8 C. 76 cu. ft. =) 8 C. 4 C. ft. 12 cu. ft. + 5 C. 7 C. ft. = 14 C. 3 C. ft. 12 cu. ft.; then, 21 C. — 14 C. 3 C. ft. 12 cu. ft. = 6 C. 4 C. ft. 4 cu. ft. = 6 C. 68 cu. ft., *Ans.*

¶ 127. *Distance of Time from one date to another.*

4. 1847th yr. 9th mo. 1st. d. — 1842d yr. 4th mo. 14th d. = 5 yrs. 4 m. 17 d., the whole time. 1843d yr. 10th mo

30th d. — 1842d yr. 4th mo. 14th d. = 1 yr. 6 mo. 16 d., time without interest. 1847th yr. 9th mo. 1st d. — 1843d yr. 10th mo. 30th d. = 3 yrs. 10 mo. 1 d., time with interest.

Subtraction of Fractional Compound Numbers.

¶ 128. 2. $\frac{3}{5}$ oz. Troy = 12 pwt.; $\frac{7}{8}$ pwt. = 21 grs.; and 12 pwt. — 21 grs. = 11 pwt. 3 grs., *Ans.*

3. $\frac{29}{32}$ bu. = 3 pks. 5 qts.; $\frac{15}{16}$ pk. = 7 qts. 1 pt.; and 3 pks. 5 qts. — 7 qts. 1 pt. = 2 pks. 5 qts. 1 pt., *Ans.*

4. $\frac{1}{24}$ mi. = 13 rds. 5 ft. 6 in.; $\frac{1}{6}$ fur. = 6 rds. 11 ft.; and 13 rds. 5 ft. 6 in. — 6 rds. 11 ft. = 6 rds. 11 ft., *Ans.*

5. $\frac{\cancel{4}}{5}$ of $(19\frac{1}{4} =)\ \frac{77}{\cancel{4}}$ gal. $= \frac{77}{5}$ gal. $= 15\frac{2}{5}$ gal. = 15 gal. 1 qt. 1 pt. $\frac{4}{5}$ gi.; $\frac{1}{2}$ of $(3\frac{4}{5} =)\ \frac{19}{5}$ qts. $= \frac{19}{10}$ qts. $= 1\frac{9}{10}$ qts. = 1 qt. 1 pt. $3\frac{1}{5}$ gi.; then, 15 gal. 1 qt. 1 pt. $\frac{4}{5}$ gi. — 1 qt. 1 pt. $3\frac{1}{5}$ gi. = 14 gal. 3 qts. 1 pt. $1\frac{3}{5}$ gi., *Ans.*

Multiplication and Division of Compound Numbers.

¶ 129. EXAMPLES FOR PRACTICE.

7. 6d. × 5 = 30d. = 2s. 6d., and 10s. × 5 = 50s., which + 2s. = 52s. = 2£. 12s. *Ans.*, 2£. 12s. 6d.

8. (2£. 12s. =) 52s. ÷ 5 = 10s. and 2s. remainder; (2s. 6d. =) 30d. ÷ 5 = 6d. *Ans.* 10s. 6d.

¶ 130. 3. 4 × 6 = 24; then, 2£. 12s. 4d. × 4 = 10£. 9s. 4d., which × 6 = 62£. 16s., *Ans.*

4. 62£. 16s. ÷ 6 = 10£. 9s. 4d., which ÷ 4 = 2£. 12s. 4d., *Ans.*

5. 8 × 7 × 2 = 112; then, 2 bu. 1 pk. × 8 = 18 bu., 18 bu. × 7 = 126 bu., which × 2 = 252 bu., *Ans.*

6. 252 bu. ÷ 2 = 126 bu., 126 bu. ÷ 7 = 18 bu., which ÷ 8 = 2 bu. 1 pk., *Ans.*; or, 252 bu. ÷ 8 = 31 bu. 2 pks., which ÷ 7 = 4 bu. 2 pks., and 4 bu. 2 pks. ÷ 2 = 2 bu. 1 pk., *Ans.*, as before.

NOTE. We see from the last operation, that the quotient is not altered by changing the order of the factors of the divisor.

7. 7 × 12 = 84; 112 gal. 2 qts. 1 pt. 3 gi. × 7 = 789 gal. 1 gi., which × 12 = 9468 gal. 1 qt. 1 pt., *Ans.*

9. 3 × 9 × 5 = 135; 2 bu. 3 pks. × 3 = 8 bu. 1 pk., 8 bu. 1 pk. × 9 = 74 bu. 1 pk., which 5 = 371 bu. 1 pk., *Ans.*

11. 5 × 5 = 25; 32 yds. 2 qrs. 1 na. × 5 = 162 yds. 3 qrs. 1 na., which × 5 = 814 yds. 1 na., *Ans.*

¶ 131. EXAMPLES FOR PRACTICE.

3. 75 A. 2 R. 25 P. × 10 = 756 A. 2 R. 10 P. in 10 lots, 756 A. 2 R. 10 P. × 10 = 7565 A. 2 R. 20 P. in 100 lots, which × 2 = 15131 A. 1 R. in 200 lots; 756 A. 2 R. 10 P. × 4 = 3026 A. 1 R. in 40 lots; then, 15131 A. 1 R. + 3026 A. 1 R. + 75 A. 2 R. 25 P. = 18233 A. 25 P., in 241 lots, *Ans.*

4. 18233 A. 25 P. ÷ 241 = 75 A. 2 R. 25 P., *Ans.*

5. 78 lbs. 9 oz. × 10 = 785 lbs. 10 oz. in 10 chests, which × 2 = 1571 lbs. 4 oz. in 20 chests; 78 lbs. 9 oz. × 3 = 235 lbs. 11 oz. in 3 chests; then, 1571 lbs. 4 oz. + 235 lbs. 11 oz. = 1806 lbs. 15 oz. in 23 chests, *Ans.*

7. 9£. 11s. 6d. × 10 = 95£. 15s., cost of 10 bales; 95£. 15s. × 10 = 957£. 10s., cost of 100 bales, which × 3 = 2872£. 10s., cost of 300 bales; 95£. 15s. × 7 = 670£. 5s., cost of 70 bales; and 9£. 11s. 6d. × 5 = 47£. 17s. 6d., cost of 5 bales; then, 2872£. 10s. + 670£. 5s. + 47£. 17s. 6d. = 3590£. 12s. 6d., cost of 375 bales, *Ans.*

NOTE. 375 in the above operation = 5 × 5 × 5 × 3.

9. 22 bu. 3 pks. 5 qts. × 10 = 229 bu. 2 qts. on 10 acres, which × 10 = 2290 bu. 2 pks. 4 qts. on 100 acres; 229 bu. 2 qts. × 2 = 458 bu. 4 qts. on 20 acres; and 22 bu. 3 pks. 5 qts. × 5 = 114 bu. 2 pks. 1 qt. on 5 acres; then, 2290 bu. 2 pks. 4 qts. + 458 bu. 4 qts. + 114 bu. 2 pks. 1 qt. = 2863 bu. 1 pk. 1 qt. on 125 acres, *Ans.*

NOTE. In the above operation 125 = 5 × 5 × 5.

¶ 132. *Difference in Longitude and Time between different places.*

3. 1° of longitude = 4 m. of time, and 11° = 4 m. × 11 = 44 m. of time; and 12 h. — 44 m. = 11 h. 16 m., that is, 16 minutes past 11 o'clock, *Ans.*

4. 4 m. of time = 1° of longitude, and 44 m. = $\frac{44}{4}$ = 11°, the difference in longitude, *Ans.*

5. A meteor is transient in its appearance, and in all places where seen, must be seen at the same instant of time;

the question, therefore, is the same as if it had been, "At 47 minutes past 11 o'clock, P. M., of Dec. 31st, 1847, at Washington, what is the time at Boston? at the Sandwich Islands?" The difference between the Washington and Boston time (26 m. 40 s.) must be added to the Washington time to find the Boston time, = 13 m. 40 s., A. M., of Jan. 1st, 1848; and the difference between the Washington and the Sandwich Island time (5 h. 9 m. 8 s.) must be subtracted from the Washington time, to give the Sandwich Island time, = 37 m. 52 s. past 6 o'clock, P. M., of Dec. 31st., 1847, *Ans.*

¶ 133. Review of Compound Numbers.

EXERCISES.

1. 3 oz. 5 pwt. × 3 × 6 = 4 lb. 10 oz. 10 pwt.; 15 pwt. 14 gr. × 4 × 6 = 1 lb. 6 oz. 14 pwt.; 9 oz. 7 pwt. × 3 = 2 lb. 4 oz. 1 pwt.; 1 lb. 9 oz. 15 pwt. × 2 = 3 lb. 7 oz. 10 pwt.; 11 oz. 18pwt. × 6 = 5 lb. 11 oz. 8 pwt.; the several products added = 18 lb. 4 oz. 3 pwt., *Ans.*

2. 27 yds. 3 qrs. × 5 × 7 = 971 yds. 1 qr., *Ans.*

3. 45 gal. 3 qts. 1 pt. × 9 = 412 gal. 3 qts. 1 pt. *Ans.*

5. 889 bu. 2 pks. 6 qts. ÷ 365 = 2 bu. 1 pk. 6 qts., the quantity which 8 horses will consume in 1 day; and 2 bu. 1 pk. 6 qts. ÷ 8 = 1 pk. 1 qt. 1 pt. 2 gi., the quantity which 1 horse will consume in 1 day, *Ans.*

6. 61£. 5s. + 195£. 13s. 11d. = 256£. 18s. 11d., and 735£. 11s. 6d. — 256£. 18s. 11d. = 478£. 12s. 7d., *Ans.*

7. 4s. 6d. × 10 = 2£. 5s.; 5s. × 12 = 3£.; 5s. 6d. × 4 = 2£. 2s., 10s. × 4 = 2£.; 11s. × 4 = 2£. 4s.; 12s. × 6 = 3£. 12s.; 14s. × 6 = 4£. 4s.; and the sum of the several products + 1£. 4s. = 19£. 11s., *Ans.*

8. 16 bar. 23 gal. 3 qts. ÷ 5 = 3 bar. 10 gal. 4⅕ qts. = 3 bar. 11 gal. ⅕ qt., *Ans.*

9. 3 × 7 = 21. 3 P. 112 sq. ft. 81 sq. in. × 3 × 7 = 1 R. 31 P. 185 sq. ft. 117 sq. in.; then, (1 A. =) 4 R. — 1 R. 31 P. 185 sq. ft. 117 sq. in. = 2 R. 8 P. 86¼ sq. ft. 27 sq. in. = 2 R. 8 P. 86 sq. ft. 63 sq. in., *Ans.*

10. 3 rds. 9 ft. 7 in. × 3 × 5 = 53 rds. 11 ft. 9 in., *Ans.*

11. 3° 18′ 45″ × 10 × 3 = 99° 22′ 30″, *Ans.*

12. 30 d. + 31 d. + 30 d. = 91 d. = 13 w.; then, 1 gr. 7 doz. × 13 = 20 gr. 7 doz., *Ans.*

13. $1000000 ÷ $100 = 10000 times = 10000 m. = 166⅔ h. = 16⅔ d. of 10 hours each, *Ans.*

14. $1000000000 ÷ $100 = 10000000 times = 10000000

m. = 166666$\frac{2}{3}$ h. = 16666$\frac{2}{3}$ d. of 10 hours each = 45 yrs. 241$\frac{2}{3}$ d., *Ans.*

15. $10000000000000000 ÷ ($100 × 1000 =) $100000 = 10000000000 times = 10000000000 m. = 166666666$\frac{2}{3}$ h. = 16666666$\frac{2}{3}$ d. of 10 hours each = 45662 yrs. 36$\frac{2}{3}$, *Ans.*

ANALYSIS.

¶ 134. EXAMPLES FOR PRACTICE.

1. 1 hhd. 15 gal. 3 qts. = ‘3125 T.; then, $302‘40 × ‘3125 = $94‘50, *Ans.*
2. $94‘50 ÷ ‘3125 = $302‘40, *Ans.*
3. $94‘50 ÷ $302‘40 = $‘3125 T. = 1 hhd. 15 gal. 3 qts., *Ans.*
4. $3\frac{1}{4}$ qts. = ‘8125 gal.; then, $2‘215 × ‘8125 = $1‘80, *Ans.*
5. $1‘80 ÷ ‘8125 = $2‘215, *Ans.*
6. $1‘80 ÷ 2‘215 = ‘8125 gal. = $3\frac{1}{4}$ qts., *Ans.*
7. $96‘72 × $\frac{5}{8}$ = $60‘45, *Ans.*
8. $60‘45 ÷ $\frac{5}{8}$ = $96‘72, *Ans.*
9. $60‘45 ÷ $96‘72 = $\frac{6045}{9672}$ = $\frac{5}{8}$ ton, *Ans.*
10. $2‘5 × ‘8 = $2, *Ans.*
11. $2 ÷ ‘8 = $2‘5, *Ans.*
12. $2 ÷ $2‘5 = ‘8 yd., *Ans.*
13. 14 cwt. = ‘7 T.; then, (27£. 10s. =) 27‘5£. × ‘7 = 19‘25£. = 19£. 5s., *Ans.*
14. (19£. 5s. =) 19‘25£. ÷ ‘7 = 27‘5£. = 27£. 10s., *Ans.*
15. (19£. 5s. =) 19‘25£. ÷ (27£. 10s. =) 27‘5£. × ‘7 T. = 14 cwt., *Ans.*
16. 1 pk. 4 qts. = ‘375 bu.; then, $1‘92 × ‘375 = $‘72, *Ans.*
18. $‘72 ÷ $1‘92 = ‘375 bu. = 1 pk. 4 qts., *Ans.*
19. 16 yds. 2 qrs. 3 na. = 16‘6875 yds.; then, $6 × 16‘6875 = $100‘125, *Ans.*
21. $100‘125 ÷ $6 = 16‘6875 yds. = 16 yds. 2. qrs. 3 na., *Ans.*
22. 1850 lbs. = ‘925 T.; then, $13 × ‘925 = $12‘025, *Ans.*
24. $12‘025 ÷ $13 = ‘925 T. = 1850 lbs., *Ans.*
27. 31 lbs. 2 oz. 1 pwt. 6 grs. = 179550 grs.; 11 pwt. 6 grs. = 270 grs.; and 179550 grs. ÷ 270 grs. = 665 times = 665 eagles, *Ans.*
28. $200 ÷ $1‘75 = 114$\frac{2}{7}$ times = 114$\frac{2}{7}$ bu. = 14 qrs. 2 bu. 1 pk. 1‘1428$\frac{4}{7}$ qts., *Ans.*

29. 3 qrs. 2 na. = ‘875 yd.; then, \$6 × ‘875 = \$5‘25, *Ans.*

30. 6500 lbs. = 3‘25 T.; then, \$22‘10 ÷ 3‘25 = \$6‘80, *Ans.*

31. 9 oz. 4 pwt. 16 grs. = $9\frac{7}{30}$ oz.; then, \$11‘08 ÷ $9\frac{7}{30}$ = $(\frac{1108}{10\cancel{0}} \times \frac{3\cancel{0}}{277} =)\ \$\frac{3324}{2770}$ = \$1‘20, *Ans.*

32. \$1‘25 ÷ \$20 = ‘0625 oz. = 1 pwt. 6 grs., *Ans.*

35. $28\frac{1}{3}$ d. × 16 = $453\frac{1}{3}$ d., the time it would take 1 man, which ÷ 12 = $37\frac{7}{9}$ d., the time it will take 12 men, *Ans.*

36. 20 yds. × $\frac{3}{4}$ yd. — 15 sq. yds., the contents of the cassimere, and 15 sq. yds. ÷ ($1\frac{1}{4}$ =) $\frac{5}{4}$ = 12 yds. of alpaca, *Ans.*

37. If we knew how much 1 horse consumed in 1 week, it would be easy to find how much 12 horses would consume in 8 weeks.

$2\frac{3}{4} = \frac{11}{4}$ tons. If 7 horses consume $\frac{11}{4}$ tons in 6 weeks, 1 horse will consume $\frac{1}{7}$ of $\frac{11}{4} = \frac{11}{28}$ of a ton in 6 weeks; and if a horse consume $\frac{11}{28}$ of a ton in 6 weeks, he will consume $\frac{1}{6}$ of $\frac{11}{28} = \frac{11}{168}$ of a ton in 1 week. 12 horses will consume 12 times $\frac{11}{168} = \frac{132}{168}$ in 1 week, and in 8 weeks they will consume 8 times $\frac{132}{168} = \frac{132}{21} = 6\frac{2}{7}$ tons, *Ans.*

38. If 5 persons drink ($7\frac{4}{5}$ =) $\frac{39}{5}$ gal. in 1 week, 1 person would drink $\frac{1}{5}$ of $\frac{39}{5} = \frac{39}{25}$ gal. in 1 week; 8 persons would drink 8 times $\frac{39}{25} = \frac{312}{25}$ gal. in 1 week, and in ($22\frac{1}{2}$ =) $\frac{45}{2}$ weeks they would drink $\dfrac{\overset{156}{\cancel{312}}}{\underset{5}{\cancel{25}}} \times \dfrac{\overset{9}{\cancel{45}}}{\cancel{2}} = \dfrac{1404}{5} = 280\frac{4}{5}$ gal., *Ans.*

39. \$11 for 7 yds. is $\frac{1}{7}$ of $\$\frac{11}{1} = \$\frac{11}{7}$ for 1 yard sold, and \$7 for 5 yds. is $\frac{1}{5}$ of $\$\frac{7}{1} = \$\frac{7}{5}$ for 1 yd. bought; now, ($\$\frac{11}{7}$ =) $\$\frac{55}{35}$ — ($\$\frac{7}{5}$ =) $\$\frac{49}{35} = \$\frac{6}{35}$ = gain on 1 yard; then, $\$\frac{200}{1} \div \$\frac{6}{35} = \frac{7000}{6} = 1166\frac{2}{3}$ yds.; and 1166 ($\frac{2}{3}$ =) $\frac{18}{27} \div 129\frac{17}{27}$ = 9 bales, *Ans.*

40. If ($\frac{1}{3}$ =) $\frac{2}{6} - \frac{1}{6} = \frac{1}{6}$ lb. cost ($13\frac{1}{5}$ =) $\frac{66}{5}$d., then 1 lb. (= $\frac{6}{6}$) will cost 6 times as much = $\frac{396}{5}$d.; (14 lbs. =) $\frac{70}{5}$ lb. — ($\frac{1}{5}$ of $\frac{2}{1}$ =) $\frac{2}{5}$ lb. = $\frac{68}{5}$, and $\frac{396}{5}$d. (cost of 1 lb.) × $\frac{68}{5}$ = $\frac{26928}{25}$d. = 4£. 9s. $9\frac{3}{25}$d., *Ans.*

41. 26 qrs. 2 bu. = 210 bu.; 5‘25 A. ÷ 210 = ‘025 A., (to produce 1 bushel,) which × 380 (the number of bushels in 47 qrs. 4 bu.) = 9‘5 A. = 9 A. 2 R., *Ans.*

42. If 9 students spend ($10\frac{7}{9}$ =) $\frac{97}{9}$£. in 18 days, 1 student will spend $\frac{1}{9}$ of $\frac{97}{9}$£. = $\frac{97}{81}$£. in 18 days, and $\frac{1}{18}$ of $\frac{97}{81}$£.

= $\frac{97}{1458}$£. in 1 day; 20 students will spend 20 times $\frac{97}{1458}$£. = $\frac{1940}{1458}$£. in 1 day, and in 30 days 30 times $\frac{1940}{1458}$£. = $\frac{58200}{1458}$£. = 39£. 18s. 4$\frac{20}{81}$d., *Ans.*

43. $\frac{1}{5}$ yd. will cost $\frac{1}{3}$ of \$$\frac{7}{8}$ = \$$\frac{7}{24}$, which × 5 = \$$\frac{35}{24}$, cost of 1 yd.; \$$\frac{35}{24}$ × (40$\frac{1}{2}$ = $\frac{81}{2}$) = \$$\frac{2835}{48}$ = \$59‘062+, *Ans.*

44. If ($\frac{7}{16}$ =) $\frac{14}{32}$ of the ship cost \$251, then $\frac{1}{32}$ part of it will cost $\frac{1}{14}$ of \$$\frac{251}{1}$ = \$$\frac{251}{14}$, and $\frac{3}{32}$ of it will cost 3 times as much = \$$\frac{753}{14}$ = \$53‘785+, *Ans.*

45. 1 cwt. = 112 lb.; then, 1 lb. will cost $\frac{1}{112}$ of (3$\frac{5}{8}$£. =) $\frac{29}{8}$£. = $\frac{29}{896}$£.; and (9$\frac{2}{3}$ =) $\frac{29}{3}$ lb. will cost $\frac{29}{3}$ as much, that is, $\frac{29}{3}$ of $\frac{29}{896}$£. = $\frac{841}{2688}$£. = 6s. 3$\frac{5}{56}$d., *Ans.*

46. $\frac{2}{3}$ of $\frac{4}{5}$ = $\frac{8}{15}$ = the part of the vessel sold; then, if $\frac{8}{15}$ of the vessel cost \$957, $\frac{1}{15}$ of it will cost $\frac{1}{8}$ of \$$\frac{957}{1}$ = \$$\frac{957}{8}$, and $\frac{15}{15}$ will cost 15 times as much = \$$\frac{14355}{8}$ = \$1794‘375, *Ans.*

47. If ($\frac{5}{8}$ yd. = $\frac{20}{8}$ qr. = $\frac{4}{8}$ E. E. = $\frac{1}{2}$ =) $\frac{15}{30}$ E. E. cost $\frac{5}{7}$£., then $\frac{1}{30}$ E. E. will cost $\frac{1}{15}$ of $\frac{5}{7}$£. = $\frac{5}{105}$£., and ($\frac{9}{15}$ =) $\frac{18}{30}$ E. E. will cost 18 times as much = $\frac{90}{105}$£. = 17s. 1d. 2$\frac{6}{7}$qr., *Ans.*

PRACTICE.

¶ 135. EXAMPLES FOR PRACTICE.

8. 12$\frac{1}{2}$ cents = $\frac{1}{8}$ of a dollar, and \$264 ÷ 8 = \$33, *Ans.*

10. \$1‘12$\frac{1}{2}$ = 1 dollar and $\frac{1}{8}$ of another dollar; 1 time \$8460 and $\frac{1}{8}$ of another time = \$9517‘50, *Ans.* At \$4‘06$\frac{1}{4}$ = 4 dollars and $\frac{1}{16}$ part of another dollar; \$8460 × 4 = \$33840; and \$8460 ÷ 16 = \$528‘75; then, \$33840 + \$528‘75 = \$34368‘75, *Ans.*

¶ 136. 3. 3460 × \$4 = \$138‘40, (removing the separatrix two places,) *Ans.*

4. 24650 × \$5 = \$123‘25, (.... three places,) *Ans.*
5. 4750 × \$12‘25 = \$58‘18$\frac{3}{4}$, (.... three places,) *Ans.*
6. 38600 × \$4‘75 = \$183‘35, (.... three places,) *Ans.*
7. 46590 × \$10‘625 = \$495‘01+, (.... three places,) *Ans.*
8. 75 × \$4 = \$3, (.... two places,) *Ans.*
9. 4000 × \$3 = \$12, (.... three places,) *Ans.*

ORDER. In ¶ 136 the sums expressed in Federal Money must precede the sign ×, and the other numbers follow it.

¶ 137. 2. \$7‘50 ÷ 2 = \$3‘75 = price of 1000 F which × 15742 = $59'032+, (removing the separatrix three places,) *Ans.*

¶ 138. EXAMPLES FOR PRACTICE.

2. 1873£. ÷ 3 = 624£. 6s. 8d., *Ans.*

5. 14s. = 10s. (= ½£.) + 4s. (= ⅕£.;) 866£. ÷ 2 = 433£., and 866£. ÷ 5 = 173£. 4s.; then, 433£. + 173£. 4s. = 606£. 4s., *Ans.*

6. 7 T. 8 cwt. = 148 cwt.; 16s. 8d. = 10s. (= ½£.) + 6s. 8d. (= ⅓£.;) 148£. ÷ 2 = 74£., and 148£. ÷ 3 = 49£. 6s. 8d.; then, 74£. + 49£. 6s. 8d. = 123£. 6s. 8d., *Ans.*

¶ 139. EXAMPLES FOR PRACTICE.

1. 4d. = ⅓s. and 348216s. ÷ 3 = 116072s. = 5803£. 12s., *Ans.*

2. 9d. = 6d. + 3d.; 2490s. ÷ 2 = 1245s. = 62£. 5s., and 2490s. ÷ 4 = 622s. 6d. = 31£. 2s. 6d.; then, 62£. 5s. + 31£. 2s. 6d. = 93£. 7s. 6d., *Ans.*

3. 4½d. = 3d. + 1½d.; 4000s. ÷ 4 = 1000s. = 50£.; and 4000s. ÷ 8 = 500s. = 25£.; then, 50£. + 25£. = 75£., *Ans.*

¶ 140. EXAMPLES FOR PRACTICE.

2. 3 qts. = 2 qts. + 1 qt.; $'94 ÷ 2 = $'47, the price of 2 qts., and $'94 ÷ 4, or $'47 ÷ 2, = $'235, the price of 1 qt.; then, $'47 + $'235 = $'70½, *Ans.*

3. 90 rds. = 80 rds. (= ¼ mi.) + 10 rds. (= $\frac{1}{32}$ mi. = ⅛ of ¼ mi.;) $1200 ÷ 4 = $300, and $1200 ÷ 32, or $300 ÷ 8, = $37'50; then, $300 + $37'50 = $337'50, *Ans.*

4. 65 lbs. = 40 lbs. (= ⅕ bar.) + 25 lbs. (= ⅛ bar.;) $17'25 ÷ 5 = $3'45, and $17'25 ÷ 8 = $2'15+; then, $3'45 + $2'15+ = $5'60+, *Ans.*

5. 14 quires = 10 quires (= ½ ream) + 4 quires (= ⅕ ream;) $3'00 ÷ 2 = $1'50, and $3'00 ÷ 5 = $'60; then, $1'50 + $'60 = $2'10, *Ans.*

8. 8 mo. = 6 mo. (= ½ yr.) + 2 mo. (= ⅓ of ½ yr.,) and 21 d. = 15 d. (= ¼ of 2 mo.) + 6 d. (= $\frac{1}{10}$ of 2 mo.;) $400 ÷ 2 = $200, $200 ÷ 3 = $66⅔, $66⅔ ÷ 4 = $16⅔, and $66⅔ ÷ 10 = $6⅔; then, $200 + $66⅔ + $16⅔ + $6⅔ = $290, *Ans.*

9. 5 C. ft. = 4 C. ft. (= ½ C.) + 1 C. ft. (= ¼ of ½ C.,) and 12 cu. ft. = 8 cu. ft. (= ½ C. ft.) + 4 cu. ft. (= ½ of ½

C. ft.;) \$2‘50 ÷ 2 = \$1‘25, \$1‘25 ÷ 4 = \$‘31¼, \$‘31¼, ÷ 2 = \$‘15⅝, which ÷ 2 = \$‘07$\frac{13}{16}$; then, \$1‘25 + \$‘31(¼ =) $\frac{4}{16}$ + \$‘15(⅝ =) $\frac{10}{16}$ + \$‘07$\frac{13}{16}$ = \$1‘79$\frac{13}{16}$, *Ans.*

10. 11 oz. = 8 oz. (= ½ lb.) + 2 oz. (= ¼ of ½ lb.) + 1 oz. (= ½ of 2 oz.;) \$‘12 ÷ 2 = \$‘06, \$‘06 ÷ 4 = \$‘015, which ÷ 2 = \$‘007½; then, \$‘06 + \$‘015 + \$‘007½ = \$‘082½, *Ans.*

11. 3 yds. = 3 times 1 yd., and ⅝ yd. = ½ yd. + ⅛ yd. (= ¼ of ½ yd.;) \$4‘00 × 3 = \$12‘00, \$4‘00 ÷ 2 = \$2‘00, which ÷ 4 = \$‘50; then, \$12‘00 + \$2‘00 + \$‘50 = \$14‘50, *Ans*

¶ 141. EXAMPLES FOR PRACTICE.

1. 9s. = ‘45£., and 7d. = ‘029£. *Ans.* ‘479£. —— 12s. = ‘6£., and ¾d. = ‘003£. *Ans.*, ‘603£.

2. 15s. = ‘75£., and 3d. = ‘012£.; 8s. = ‘4£., and 11½d. = ‘048£.; 10s. = ‘5£., and 6¼d. = ‘026£.; 1s. = ‘05£., and 8½d. = ‘035£.; ½d. = ‘002£.; 2¼d. = ‘009£. *Amount*, £1‘833.

¶ 142. 1. *It will be most convenient to decompose the fraction in the following manner:* ‘5£. = 10s., and ‘023£. = 22 (abating 1) = 22qr. = 5½d. *Ans.*, 10s. 5½d. —— ‘694£. (= ‘65£.) = 13s. + (‘044£. =) 42 (abating 2) = 42 qr. = 10½d. *Ans.*, 13s. 10½d.

2. ‘45£. = 9s., and ‘020£. = 4¾d. *Ans.*, 9s. 4¾d.

3. ‘75£. = 15s., and ‘035£. = 34qr. = 8½d.; ‘35£. = 7s., and ‘007£. = 1¾d.; ‘9£. = 18s., and ‘016£. = 3¾d.; ‘7£. = 14s., and ‘040£. = 9½d.; ‘5£. = 10s.; ‘25£. = 5s.; ‘05£. = 1s., and ‘040£. = 9½d.; ‘008£. = 2d. *Amount*, 3£. 12s. 11d.

PERCENTAGE.

¶ 143. EXAMPLES FOR PRACTICE.

4. 895 lbs. × ‘09 = 80‘55 lbs., and 895 lbs. — 80‘55 lbs. = 814‘45 lbs., *Ans.*

5. 725 bar. × ‘28 = 203 bar. thrown overboard, and 725 bar. — 203 bar. = 522 bar. saved, *Ans.*

6. ‘125 of any sum or number = ⅛ of the sum or number hence, \$692,75 ÷ 8 = \$86‘59⅜, *Ans.*

7. 33⅓ per cent. = ⅓ of the whole number; hence, 639 sheep + ($\frac{639}{3}$ =) 213 sheep = 852 sheep, *Ans.*

8. \$1942‘715 × ‘16375 = \$318‘1195+, the sum paid, and \$1942‘715 — \$318‘1195+ = \$1624‘595+, *Ans.*

9. \$4861 × ‘285 = \$1385‘385, *Ans.*

10. \$115 × ‘0075 = \$‘$862\frac{1}{2}$, *Ans.*

11. \$376 × ‘00875 = \$3‘29, *Ans.*

13. \$1960 × ‘22 = \$431‘20, due in 3 mo., and \$1960 — \$431‘20 = \$1528‘80, due in 6 mo., *Ans.*

15. 100 per cent. — 63 per cent. = 37 per cent., the loss; then, \$3615 × ‘37 = \$1337‘55, *Ans.*

16. At each transaction he saves 85 per cent. of what he has before the transaction. \$5000 × ‘85 = \$4250, the value of the farm; \$4250 × ‘85 = \$3612‘50, what he receives for the farm; \$3612‘50 × ‘85 = \$3070‘625, what he has left after his excursion to the west; \$3070‘625 × ‘85 = \$2610‘$031\frac{1}{4}$, what he has left after speculating in railroad stocks; and \$2610‘$031\frac{1}{4}$ × ‘85 = \$2218‘526+, what he has left on quitting trade, *Ans.*

Mutual Insurance.

¶ 145. EXAMPLES FOR PRACTICE.

2. \$2845 × ‘12 = \$341‘40, am't of the premium note, $10\frac{1}{2}$ per cent. of which = \$35‘847, *Ans.*

3. \$2845 × ‘15 = \$426‘75, am't of premium note, $10\frac{1}{2}$ per cent. of which = \$44‘$808\frac{3}{4}$, *Ans.*

4. \$5000 × ‘22 = \$1100, am't of premium note, 7 per cent. of which = \$77, cost of 5 years insurance, and \$77 ÷ 5 = \$15‘40, cost per year, *Ans.*

5. \$3200 × ‘11 = \$352, am't of premium note, $10\frac{1}{12}$ per cent. of which = \$35‘$49\frac{1}{3}$, the whole sum paid, *Ans.*

6. $\frac{1}{2}$ per cent. of \$3200 = \$16, the cost of insurance for 1 year, and \$16 × 5 = \$80, the cost for 5 years; then \$80 — \$35‘$49\frac{1}{3}$ = \$44‘$50\frac{2}{3}$, *Ans.*

7. \$750 × ‘06 = \$45, am't of premium note, $13\frac{1}{2}$ per cent. of which = \$6‘$07\frac{1}{2}$, cost of 5 years' insurance, and \$6‘$07\frac{1}{2}$ ÷ 5 = \$1‘$21\frac{1}{2}$, cost of 1 year's insurance, *Ans.*

8 \$900 × ‘05 = \$45, am't of premium note, 6 per cent of which = \$2‘70, *Ans.*

Stocks.

¶ 146. EXAMPLES FOR PRACTICE.

1. \$100 × 35 × ($\frac{120}{100}$ =) 1‘20 = \$4200, *Ans.*

2. 100 per cent. + 7½ per cent. = 107½ per cent.; then, $100 × 15 × 1‘075 = $1612‘50, *Ans.*

3. (100 — 1¼ =) 98¾ per cent.; then, $2000 × ‘9875 = $1975, *Ans.*

4. (100 — 11¼ =) 88¾ per cent.; then, $2800 × ‘8875 = $2485, *Ans.*

6. (100 + 9½ =) 109½ per cent.; $3000 × 1‘095 = $3285, *Ans.*

7. (100 — 1½ =) 98½ per cent.; $5000 = ‘985 = $4925, *Ans.*

Brokerage.

¶ 147. EXAMPLES FOR PRACTICE.

4. $5000 × ‘0025 = $12‘50, the brokerage, and $5000 + $12‘50 = $5012‘50, *Ans.*

6. $6000 × 1‘01 = $60, *Ans.*

7. $5200 × ‘005 = $26, and $5200 — $26 = $5174, *Ans.*

Profit and Loss.

¶ 148. EXAMPLES FOR PRACTICE.

2. $60 × ‘20 = $12, the gain, and $60 + $12 = 72, *Ans.;* or, I must sell it for $\frac{120}{100}$ of what it cost me, that is, for 120 per cent. of $60; $60 × 1‘20 = $72, *Ans.*, as before.

3. I must sell it for (100 — 12 =) 88 per cent. of what it cost me; $2‘50 × ‘88 = $2‘20, *Ans.*

4. To gain 5 per cent., I must sell it for 105 per cent. of what it cost me, that is for 5 per cent. advance; $‘20 × 1‘05 = $‘21, *Ans.*, &c. To gain 10 per cent., I must sell it for 110 per cent. of $‘20 = $‘22, *Ans.* To gain 15 per cent., I must sell it for 115 per cent. of $‘20 = $‘23, *Ans.* To lose 20 per cent., I must sell it for (100 — 20 =) 80 per cent. of $‘20 = $‘16, *Ans.*

Interest.

¶ 150. EXAMPLES FOR PRACTICE.

2. $450 × ‘05 = $22‘50, the interest for 1 year, which ÷ 4 = $5‘62½, the interest for (¼ yr. =) 3 months, and $5‘62½ × 3 = $16‘87½, the interest for (¾ yr. =) 9 months; then, $450 + $16‘87½ = $466‘87½, the amount, *Ans.*

3. $87‘50 × ‘08 = $7, interest for 1 yr., which ÷ 2 =

$3‘50, interest for 6 mo.; and $3‘50 ÷ 6 = $‘583+, interest for 1 mo.; then, $3‘50 + $‘583+ = $4‘083+, interest for 7 mo., and $87‘50 + $4‘083+ = $91‘583+, *Ans.*

4. $163 × ‘07 = $11‘41, interest for 1 yr., which ÷ 3 = $3‘803+, interest for 4 mo., *Ans.*

5. $850 × ‘06 = $51, interest for 1 yr., which ÷ 6 = $8‘50, interest for 2 mo., and $8‘50 × 5 = $42‘50, interest for 10 mo., *Ans.*

¶ 151. EXAMPLES FOR PRACTICE.

2. $400 × ‘08 = $32, interest for 1 yr.; $32 ÷ 4 = $8, interest for 3 mo.; and $8 ÷ 10 = $‘80, interest for 9 days, *Ans.* NOTE. 9 days = $\frac{9}{90}$ = $\frac{1}{10}$ of 3 months.

3. $75 × ‘08 = $6, for 1 yr.; $6 ÷ 12 = $‘50, for 1 mo.; $‘50 ÷ 2 = $‘25, for 15 d.; $‘50 ÷ 15 = $‘03$\frac{1}{3}$, for 2 d.; which × 2 = $‘06$\frac{2}{3}$, for 4 d.; then, $‘25 + $‘06$\frac{2}{3}$ = $‘31$\frac{2}{3}$, for 19 d., *Ans.*

4. $500 × ‘08 = $40, for 1 yr.; $40 ÷ 12 = $3‘33$\frac{1}{3}$, for 1 mo.; $3‘33$\frac{1}{3}$ ÷ 6 = $‘55$\frac{5}{9}$, for 5 d., which × 5 = $2‘777+ for 25 d., *Ans.*

¶ 152. EXAMPLES FOR PRACTICE.

1. $84 × ‘08 = $6‘72, for 1 yr.; $6‘72 ÷ 4 = $1‘68, for 3 mo., which × 3 = $5‘04, for 9 mo.; $1‘68 ÷ 9 = $‘18$\frac{2}{3}$, for 10 d., which × 2 = $‘37$\frac{1}{3}$, for 20 d.; then, $6‘72 + $5‘04 + $‘37$\frac{1}{3}$ = $12‘133+, *Ans.*

2. $147 × ‘07 = $10‘29, for 1 yr., which × 2 = $20‘58, for 2 yrs.; $10‘29 ÷ 6 = $1‘71$\frac{1}{2}$, for 2 mo., which × 4 = $6‘86, for 8 mo.; $1‘71$\frac{1}{2}$ ÷ 5 = $‘343, for 12 d.; then, $20‘58 + $6‘86 + $‘343 = $27‘783, *Ans.*

3. $248 × ‘09 = $22‘32, for 1 yr., which × 2 = $44‘64, for 2 yrs.; $22‘32 ÷ 2 = $11‘16, for 6 mo.; and $11‘16 ÷ 9 = $1‘24, for 20 d.; then, $44‘64 + $11‘16 + $1‘24 = $57‘04, *Ans.*

4. $161‘08 × ‘07 = $11‘2756, for 1 yr.; $11‘2756 ÷ 12 = $‘9396$\frac{1}{3}$, for 1 mo., which × 11 = $10‘3359$\frac{2}{3}$, for 11 mo.; $‘9396$\frac{1}{3}$ ÷ 2 = $‘4698$\frac{1}{6}$, for 15 d.; $‘9396$\frac{1}{3}$ ÷ 10 = $‘09396$\frac{1}{3}$ for 3 d., which ÷ 3 = $‘03132$\frac{1}{9}$, for 1 d.; the sum of the interests for 11 mo., 15 d., 3 d. and 1 d. = $10‘931+, *Ans.*

5. $73‘25 × ‘08 = $5‘86, for 1 yr.; $5‘86 ÷ 4 = $1‘465, for 3 mo., which × 3 = $4‘395, for 9 mo.; $5‘86 ÷ 6 = $‘976$\frac{2}{3}$, for 2 mo., which ÷ 5 = $‘195$\frac{1}{3}$, for 12 d.; the sum of the interest for 1 yr. 9 mo. 12 d. = $10‘45+, *Ans.*

6. $910‘50 × ‘07 = $63‘735, for 1 yr., which × 3 =

$191'205, for 3 yrs.; $63'735 ÷ 4 = $15'933¾, for 3 mo., which × 3 = $47'801¼, for 9 mo.; $15'933¾ ÷ 3 = $5'311¼, for 1 mo., which ÷ 3 = $1'770$\frac{5}{12}$, for 10 d.; and $1'770$\frac{5}{12}$ × 2 = $3'540⅚, for 20 d., and $5'311¼ ÷ 5 = $1'062¼, for 6 d.; the sum of the interest for 3 years 9 mo. 20 d. and 6 d. = $243'609+, *Ans.*

7. $185'26 × '075 = $13'894½, for 1 yr., which × 2 = $27'789, for 2 yrs.; $13'894½ ÷ 4 = $3'473⅝, for 3 mo.; $3'473⅝ ÷ 9 = $'385$\frac{69}{72}$, for 10 d., which ÷ 10 = $'038+, for 1 d.; the sum of the interests for 2 yrs. 3 mo. 10d. and 1 d. = $31'687+, which + $185'26 = $216'947+, *Ans.*

9. $46'28 × '05 = $2'314, for 1 yr., which × 2 = $4'628, for 2 yrs.; $2'314 ÷ 4 = $'5785, for 3 mo.; $'5785 ÷ 9 = $'06427+, for 10 d., which ÷ 10 = $'006427+, for 1 d.; and the interest for 1 d. × 23 = $'1478+, for 23 d.; the sum of the interests for 2 yrs. 3 m. and 23 d. = $5'354+, *Ans.*

10. $175'25 × '06 = $10'515, for 1 yr., which × 5 = $52'575, for 5 yrs.; $10'515 ÷ 12 = $'876¼, for 1 mo., which × 8 = $7'01, for 8 mo.; $'876¼ ÷ 5 = $'175¼, for 6 d., which × 3½ (6 d. × 3½ = 21 d.) = $'613⅜, for 21 d.; the sum of the interests for 5 yrs. 8 mo. and 21 d. + $175'25 = $235'448+, *Ans.*

11. $96'50 ÷ 8 = $12'06¼, for 1 yr., which × 2 = $24'12½, for 2 yrs.; $12'06¼ ÷ 12 = $1'0052$\frac{1}{12}$, for 1 mo., which ÷ 30 = $'0335+, for 1 d.; then, $24'125 — $'0335 = $24'091+, for 1 yr. 11 mo. 29 d.; and $96'50 + $24'091 = $120'591+, *Ans.*

12. $54'81 × '05 = $2'7405, for 1 yr., which ÷ 2 = $1'37025, for 6 mo.; whence, $4'11+, *Ans.*

13. $500 × '08 = $40, for 1 yr.; $40 ÷ 4 = $10, for 3 mo., which × 3 = $30, for 9 mo.; $10 ÷ 10 = $1, for 9 days; then, $30 + $1 = $31, *Ans.*

14. $62'12 × '04 = $2'4848, for 1 yr., which ÷ 12 = $'2070⅔, for 1 mo.; and ⅔ of $'2070⅔ = $'1380$\frac{4}{9}$, for 20 d.; then, $'2070⅔ + $'1380$\frac{4}{9}$ = $'345+, *Ans.*

15. $85 ÷ 8 = $10'625, for 1 yr.; 10 mo. 15 d. = ⅞ of 1 yr.; then, $10'625 — (⅛ of $10'625 =) $1'328⅛ = $9'296+, *Ans.*

16. $53 × '10 = $5'30, for 1 yr., which ÷ 2 = $2'65, for 6 mo.; $2'65 ÷ 6 = $'441⅔, for 1 mo.; and $2'65 + $'441⅔ + $53 = $56'091+, *Ans.*

23. $57'78 × '04 = $2'3112, for 1 year; $2'3112 ÷ 3 = $'7704, for 4 mo.; $'7704 ÷ 8 = $'0963, for 15 d., $\frac{2}{15}$ of

which = $‘01284, for 2 d.; the sum of the interest for 1 yr. 4 mo. 15 d. and 2 d. = $3‘19+, *Ans.*

24. From May 19th, 1847, till Aug. 11th, 1848, is 1 yr. 2 mo. 22 d.; $298‘59 × ‘08 = $23‘8872, for 1 yr.; $23‘8872 ÷ 6 = $3‘9812, for 2 mo.; $3‘9812 ÷ 3 = $1‘32706+, for 20 d., which ÷ 10 = $‘1327+, for 2 d.; the sum of the interests for 1 yr. 2 mo. 20 d. and 2 d. = $29‘328+, which + $298‘59 = $327‘918+, *Ans.*

25. From June 14th, 1847, till April 29th, 1848, is 10 mo. 15 d. = $\frac{7}{8}$ yr.; $196 × ‘0575 = $11‘27, for 1 yr.; and $11‘27 — ($\frac{1}{8}$ of $11‘27 =) $1‘40$\frac{7}{8}$ = $9‘86$\frac{1}{8}$, for 10 mo. 15 d.; then, $196 + $9‘86$\frac{1}{8}$ = $205‘861$\frac{1}{4}$, *Ans.*

¶ 154. EXAMPLES FOR PRACTICE.

3. $194 × ‘022 = $4‘268, *Ans.*
4. $263‘48 × ‘0135 = $3‘556+, *Ans.*
5. $985 × ‘34 = $334‘90, which + $985 = $1319‘90, *Ans.*
6. $87‘19 × ‘075 = $6‘539+, *Ans.*
7. $116‘08 × ‘058$\frac{1}{6}$ = $6‘751+, *Ans.*
8. $200 × ‘040$\frac{2}{3}$ = $8‘133+, *Ans.*
9. $‘85 × ‘095 = ‘08+, *Ans.*
10. $8‘50 × ‘107 = $‘909+, *Ans.*
11. $675 × ‘0085 = $5‘737+, *Ans.*
12. $8673 × ‘001$\frac{2}{3}$ = $14‘455, *Ans.*
13. $‘73 × ‘05 = $‘036+, *Ans.*
14. $126‘46 × ‘045 = $5‘69+, *Ans.*
15. $318 × ‘052$\frac{2}{3}$ = $16‘748, *Ans.*
16. $418 × ‘097$\frac{5}{6}$ = $40‘894+, *Ans.*
17. $268‘44 × ‘209$\frac{1}{3}$ = $56‘193+, *Ans.*
18. $658 × ‘045 = $29‘61, *Ans.*
19. $96 × ‘0005 = $‘048; or, $‘096 ÷ 2 = $‘048, *Ans.*, as before.
20. $73‘50 × ‘000$\frac{1}{3}$ = $‘0245; or, $‘0735 ÷ 3 = $‘0245, *Ans.*, as before.
21. 5 days = $\frac{1}{3}$ + $\frac{1}{2}$ of 6 days; therefore, $‘180 (making no account of the cents) ÷ 3 and by 2 (and uniting the two quotients) = $‘15, *Ans.*
22. $15000 × ‘000$\frac{1}{6}$ = $2‘50; or, $15 ÷ 6 = $2‘50, *Ans.*, as before.

¶ 155. 2. $1000 × ‘06 = $60, which × 120 = $7200 *Ans.*

3. The int. for 10 years is $240; $400 × ‘016 = $6‘40 for 3 mo. 6 days.; then, $240 + 6‘40 = $246‘40, *Ans.*

6. The int. for 9 yrs. is $405; $750 × ‘0221$\frac{1}{3}$ = $16‘75 for 4 mo. 14 d.; then, $750 + $405 + $16‘75 = $1171‘75, *Ans.*

¶ 156. 1. 36‘477£. × ‘06 = 2‘183+£. = 2£. 3s. 9d., *Ans.*

2. 36‘5£. × ‘093$\frac{1}{3}$ = 3‘406+£. = 3£. 8s. 1$\frac{1}{2}$d., *Ans.*

4. 18‘6£. × ‘0505 = ‘939+£., which + 18‘6£. = 19‘539+£. = 19£. 10s. 9$\frac{1}{4}$d., *Ans.*

7. 640‘4£. × ‘06 = 38‘424£., (int. for 1 yr.,) which + 640‘4£. = 678‘824£. = 678£. 16s. 5$\frac{3}{4}$d., amount for 1 yr.; 38‘424£. × 2$\frac{1}{2}$ = 96‘06£., (int. for 2$\frac{1}{2}$ yrs.,) which + 640‘4£. = 736‘46£. = 736. 9s. 2$\frac{1}{2}$d., amount for 2 yrs. 6 mo., &c.

8. 391‘85£. × ‘045 = 17‘63325£., (int. for 1 yr.,) which × 3 = 52‘89975£., (int. for 3 yrs.;) 17‘63325£. ÷ 4 = 4‘40831+, (interest for 3 mo.;) then, 391‘85£. + 52‘89975£. + 4‘40831£. = 449‘158+£. = 449£. 3s. 2d.

9. 8 mo. 18 d. = the time; 235‘188£. × ‘0525 = 12‘34737£., (int. for 1 yr.,) $\frac{2}{3}$ of which = 8‘23158£., (int. for 8 mo.;) $\frac{1}{20}$ of 12‘34737£. = ‘61736+£., (int. for 18 d.;) then, 235‘188£. + 8‘23158£. + ‘61736£. = 244‘036+£. = 244£. 8$\frac{3}{4}$d., *Ans.*

¶ 157. *To calculate interest on notes, &c., when partial payments have been made.*

2.

First principal on int. from March 8th, 1843,		$867‘33
Payment, Apr. 16th, 1843, (exceeding int. due,)	$136‘44	
Int. to time of 1st payment, (1 mo. 8 d.,)	6‘408	130‘032
Remainder for a new principal,		$737‘298
Payment, Apr. 16th, 1845,	$319	
Int. to time of 2d payment, (2 yrs.,)	103‘221	215‘779
Remainder for a new principal,		$521‘519
Payment, Jan. 1st, 1846,	$518‘68	
Int. to time of 3d payment, (8 mo. 15 d.,)	25‘858	492‘822
Remainder for a new principal,		$28‘697
Int. to July 11th, 1847, (1 yr. 6 mo. 10 d.,)		3‘068
Balance due July 11th, 1847,		$31‘765

3. First principal on int. from Jan. 1st, 1840,		$1000
Payment, Apr. 1st, 1840,	$24	
Int. to time of 1st payment, (3 mo.,)	15	9
Remainder for a new principal,		$991
Payment, Aug. 1st, 1840, less than int. then due,	$4	
Payment, Dec. 1st, 1840, less than int. then due,	6	
Payment, Feb. 1st, 1841,	60	
Amount, exceeding int. due,	$70	
Int. to time of 4th payment, (10 mo.,)	49‘55	20‘45
Remainder for a new principal,		$970‘55
Payment, July 1st, 1841,	$40	
Int. to time of 5th payment, (5 mo.,)	24‘263	15‘737
Remainder for a new principal,		$954‘813
Payment, June 1st, 1844,	$300	
Int. to time of 6th payment, (2 yrs. 11 mo.,)	167‘092	$132‘908
Remainder for a new principal,		$821‘905
Payment, Sept. 1st, 1844, less than int. then due,	$12	
Payment, Jan. 1st, 1845, less than int. then due,	15	
Payment, Oct. 1st, 1845,	50	
Amount, exceeding int. due,	$77	
Int. to time of 9th payment, (1 yr. 4 mo.,)	65‘752	11‘248
Remainder for a new principal,		$810‘657
Int. to June 1st, 1846, (8 mo.,)		32‘426
Balance due June 1st, 1846,		$843‘083+.
4. Amount of $300, for 11 mo. 22 d.,		$323‘466
Amount of $116, for 4 mo. 12 d.,	$119‘402	
Amount of $49‘50, for 3 mo.,	50‘49	
Amount of $85, for 1 mo. 6 d.,	85‘68	255‘572
Balance due June 2d, 1847,		$67‘894+.

¶ 158. CONNECTICUT METHOD.

First principal on int. from Jan 1st, 1841,		$1100
Payment, Sept. 1st, 1841, less than int. then due,	$30	
Payment, Apr. 1st, 1842,	200	
Amount, exceeding int. due,	$230	
Int. to time of 2d payment, (1 yr. 3 mo.,)	82‘50	147‘50
Remainder for a new principal,		$952‘50
Payment, Dec. 1st, 1842,	$180	
Int on 3d payment, (4 mo.,)	3‘60	
Amount of 3d payment,	$183‘60	
Int. on prin. to Apr. 1st, 1843, (1 yr.,)	57‘15	126‘45
Remainder for a new principal,		$826‘05
Payment, March 1st, 1844,	$195	
Int. on 4th payment, (1 mo.,)	‘975	
Amount of 4th payment,	$195‘975	
Int. on prin. to Apr. 1st, 1844, (1 yr.,)	49‘563	146‘412
Remainder for a new principal,		$679‘638
Payment, Sept. 16th, 1844,	$250	
Int. on 5th payment, (6 mo. 15 d.,)	8‘125	
Amount of 5th payment,	$258‘125	
Int. on prin. to Apr. 1st, 1845, (1 yr.,)	40‘778	217‘347
Remainder for a new principal,		$462‘291
Payment, May 16th, 1846,	$100	
Int. on prin. to May 16, 1846, (1 yr. 1½ mo.,)	31‘204	68‘796
Remainder for a new principal,		$393‘495
Payment, July 16th, 1846,	$170	
Int. on 7th payment, (6 mo.,)	5‘10	
Amount of 7th payment,	$175‘10	
In. on prin. to Jan. 16th, 1847, (8 mo.,)	15‘739	159‘361
Balance due Jan. 16th, 1847,		$234‘134+.

¶ 159. *For calculating interest on a note in Vermont.*

EXAMPLE.

$200 — $48 (int. on $800, 1 y.) = $152, and $800 — $152 = $648, new principal.
$200 — $77'76 (int. on $648, 2 y.) = $122'24, and $648 — $122'24 = $525'76, new pr.
$300 — 31'545 (int. on n. p. 1 y.) = $268'455, and $525'76 — $268'455 = $257'305, n. p.
Sept. 1, 1845, int. on 257'305, 1 year, 15'438
" " " Balance due, $272'743+, *A.*

NOTE. By the rule as revised in 1850.

¶ 161. Compound Interest.

2. $1 at 6 per cent., by the table, for 4 years, is $1'26247+, which × 40'20 (a decimal number = to the principal) = $50'751+, the amount of $40'20 for 4 yrs., &c. $3,20173+ (the amount of $1 for 20 yrs. at 6 per cent.) × 40'20 = $128'9266+, (amount of 40'20 for 20 yrs.,) which × 1'033 (the amount of $1 for 6 mo. 18 d.) = $133'181+, *Ans.*

3. The amount of $1, at 7 per cent., by the table, for 16 years, is $2'95216+, which × 750 = $2214'12, *Ans.*

4. The amount of $1, at 8 per cent., for 20 years, is $4'629219+, which × 150 = $694'382+, *Ans.*

¶ 162. Annual Interest.

2. Interest on the principal, $1000,	5 yrs.	3 mo.,	$315
" " 1st year's int. ($60)	4 "	3 "	15'30
" " 2d " " "	3 "	3 "	11'70
" " 3d " " "	2 "	3 "	8'10
" " 4th " " "	1 yr.	3 "	4'50
" " 5th " " "		3 "	'90
Amount of interest, ...			$355'50

Then, $1000 + $355'50 = $1355'50, amount due, *Ans.*

Time, rate, and amount given, to find the principal.

¶ 163. 2. $85'12 ÷ $1'12 (amount of $1, at given rate and time) = $76, *Ans.*

3. $99'311 ÷ $1'0565 = $94, *Ans.*

4. $1500 ÷ $1'05 (amount of $1 for 4 mo., at 15 per cent.) = $1428'571+, value of the wheat, *Ans.*

Discount.

¶ 164. 3. $18 ÷ $1'075 = $16'744+, *Ans.*

4. $56'20 ÷ $1'10 = $51'09+, present worth, discount-

ing at 6 per cent. —— $56‘20 ÷ $1‘15 = $48‘869+, present worth, discounting at 9 per cent., *Ans.*

5. $834 ÷ $1‘112 (amount of $1, at given rate and time) = $750, *Ans.*

6. $321‘63 ÷ $1‘24 = $259‘379+, (the present worth,) and $321‘63 — $259‘379 = $62‘25+, *Ans.*

7. ½ of $650 = $325, which ÷ $1‘02 (am’t of $1 for 4 mo.) = $318‘6274+, and $325 ÷ $1‘04 (am’t of $1 for 8 mo.) = $312‘50; then, $318‘6274 + $312‘50 = $631‘1274, and $650 — $631‘1274 = $18‘872+, *Ans.*

8. $5378 ÷ $1‘06 = $5073‘5849+, the value of the goods; $5073‘584 × ‘035 = $177‘575+, the interest on the purchase money 6 mo., at 7 per cent.; $5378 — $5073‘5849 = $304‘415+, the difference between the cash price of the goods and the sum paid for them on 6 mo. credit; $304‘415 — $177‘575 = $126‘84, gain on one purchase, which × 50 (the number of purchases in 20 years) = $6342, *Ans.*

Commission.

¶ 165. 2. $2475 ÷ $1‘05 = $2357‘1428+, to be paid out, and $2475 — $2357‘1428 = $117‘857+, *Ans.*

3. $4820 ÷ $1‘075 = $4483‘72+, to be paid out, and $4820 — $4483‘72 = $336‘28, amount of his commission, *Ans.*

¶ 166. EXAMPLES FOR PRACTICE.

2. $4‘52 ÷ $‘08 = $56‘50, *Ans.*
3. $20 ÷ $‘06 = $333‘33⅓, *Ans.*
4. $562 ÷ $‘10 = $5620, *Ans.*

¶ 167. *Principal, interest, and time given, to find the rate per cent.*

EXAMPLES FOR PRACTICE.

2. The interest of $468 1 year, at 1 per cent., is $4‘68, which ÷ 12 = $‘39, the interest, at 1 per cent., 1 month; then, $2‘34 ÷ $‘39 = 6 per cent., *Ans.*

3. $46‘80 ÷ $10‘40 = 4½ per cent., *Ans.*

4. 1 per cent. of $1000 (the value of the stock) = $10; then, $100 (yearly dividend) ÷ $10 = 10 per cent., *Ans.*

5. 1 per cent. of $5400 = $54; then, $324 ÷ $54 = 6 per cent., *Ans.*

¶ 168. EXAMPLES FOR PRACTICE.

2. The interest on $226'50, 1 year, is $13'59; therefore, $31'71 ÷ $13'59 = 2'33$\frac{1}{3}$ years = 2 years and 4 months, *Ans.*

3. $20 ÷ $48 (int. 1 year) = '416$\frac{2}{3}$ years = 5 months, *Ans.*

4. $28'242 ÷ $8'69 = 3'25 years, very nearly = 3 years 3 months, *Ans.*

¶ 169. EXAMPLES FOR PRACTICE.

2. $\frac{66}{550}$ = '12 = 12 per cent., *Ans.*

3. $\frac{3850}{55000}$ = '07 = 7 per cent.; $\frac{2475}{55000}$ = '045 = 4$\frac{1}{2}$ per cent.; $\frac{275}{55000}$ = '005 = $\frac{1}{2}$ per cent., *Ans.*

4. $1'0032 — $'96 = $'0432, (gain per gal.,) which × 114 = $4'924+, the whole gain; and $\frac{432}{9600}$ = '045 = 4$\frac{1}{2}$ per cent., *Ans.*

5. $26 × 30 = $780, which — $698'33 (first cost and charges) = $81'67; then, $\frac{8167}{69833}$ = '11695+ = 11'695+ per cent., *Ans.*

7. $\frac{250}{100000}$ = '0025 = $\frac{1}{4}$ per cent., *Ans.*

Bankruptcy.

¶ 170. EXAMPLES FOR PRACTICE.

1. If $300000 be divided into 800000 equal parts, 1 of the parts will be the sum paid on $1. $300000 ÷ 800000 = $'37$\frac{1}{2}$, that is, 37$\frac{1}{2}$ per cent., *Ans.*

3. $4653 ÷ $6755'50 (amount of his debts) = $'68$\frac{11852}{13511}$ = the sum paid on $1; this sum, (which is the rate per cent. paid to his creditors,) multiplied by the amount of each man's claim, will give his respective share. *Ans.*, A will receive $172'193; B, $220'407; C, $344'386; D, $123'978; E, $482'14; F, $268'621; G, $45'114; H, $895'403; I, $1515'298; and J, $585'456.

¶ 171. General Average.

$3476'22 + $197 + $160 = $3833'22, the whole loss, which ÷ $38538 (total value of the ship, cargo and $\frac{2}{3}$ of the freight) = '09$\frac{36480}{38538}$ = 9$\frac{6080}{6423}$ per cent. of the whole loss; $6870 × '09$\frac{6080}{6423}$ = $683'331+, Goodrich & Co.'s loss, and $6870 — $683'331 = $6186'669, what they realize for their flour; $10232 × '09$\frac{6080}{6423}$ = $1017'735+, ship's portion of the loss; $3200 × '09$\frac{6080}{6423}$ = $318'291+, freight's portion of the loss; $4000 × '09$\frac{6080}{6423}$ = $397'863+, M. H. New-man & Co.'s loss; \$5236 × ‘09$\frac{6080}{6423}$ = \$520‘803+, D. Appleton's loss; \$9000 × ‘09$\frac{6080}{6423}$ = \$895‘193+, Hyde & Duren's loss. *Ans.*

Partnership.

¶ 172. EXAMPLES FOR PRACTICE.

2. A's loss will be ($\frac{175}{875}$ =) $\frac{1}{5}$ of \$250 = \$50; B's loss will be ($\frac{200}{875}$ =) $\frac{8}{35}$ of \$250 = \$57‘142$\frac{6}{7}$; and C's loss will be ($\frac{500}{875}$ =) $\frac{4}{7}$ of \$250 = \$142‘857$\frac{1}{7}$, *Ans.*

3. The 1st person will have $\frac{1}{6}$ of \$600 = \$100; the 2d, $\frac{2}{6}$ of \$600 = \$200; and the 3d, $\frac{3}{6}$ of \$600 = \$300, *Ans.*

4. A must lose ($\frac{350}{500}$ =) $\frac{7}{10}$ of 100 hhds. = 70 hhds., and B must lose ($\frac{150}{500}$ =) $\frac{3}{10}$ of 100 hhds. = 30 hhds., *Ans.*

5. Since \$45 is $\frac{3}{5}$ of the stock, $\frac{1}{3}$ of \$45 = \$15 is $\frac{1}{5}$ of it, which × 2 = \$30, B's share of the stock, *Ans.*

6. A put in \$1 as often as B put in \$2; hence, the whole stock consisted of 3 parts, 1 of which was A's share, and 2 were B's; $\frac{1}{3}$ of \$400 = \$133‘333$\frac{1}{3}$ = A's stock, and $\frac{2}{3}$ of \$400 = \$266‘666$\frac{2}{3}$ = B's stock, *Ans.*

7. A's gain was $\frac{5}{7}$ of \$164 = \$117‘142$\frac{6}{7}$, B's was $\frac{2}{7}$ of \$164 = \$46‘857$\frac{1}{7}$, and A received \$117‘142$\frac{6}{7}$ — \$46‘857$\frac{1}{7}$ = \$70‘285$\frac{5}{7}$ for his trouble, *Ans.*

8. \$120 (= 1 share) × ‘15 = \$18, profit to 1 share; \$18 × 2 = \$36, to 2 shares; \$18 × 25 = \$450, to 25 shares, *Ans.*

9. \$340 ÷ 100 (no. of shares) = \$3‘40, tax on 1 share; \$3‘40 × 10 = \$34, tax on 10 shares, *Ans.*

10. A should pay ($\frac{24}{40}$ =) $\frac{3}{5}$ of \$10 = \$6, and B should pay ($\frac{16}{40}$ =) $\frac{2}{5}$ of \$10 = \$4, *Ans.*

¶ 173.

$$\text{2. }\left.\begin{array}{l}\left.\begin{array}{l}\text{A, \$100 for 6 mo.} = \text{\$600 for 1 mo.}\\ \text{“ \$150 “ 6 “} = \text{\$900 “ 1 “}\end{array}\right\}\text{\$1500}\\ \left.\begin{array}{l}\text{B, \$200 “ 4 “} = \text{\$800 “ 1 “}\\ \text{“ \$120 “ 8 “} = \text{\$960 “ 1 “}\end{array}\right\}\text{\$1760}\end{array}\right\} = \text{\$3260.}$$

Then, A would receive ($\frac{1500}{3260}$ =) $\frac{75}{163}$ of \$95 = \$43‘711$\frac{107}{163}$, and B would receive ($\frac{1760}{3260}$ =) $\frac{88}{163}$ of \$95 = \$51‘288$\frac{56}{163}$, *Ans.*

$$\text{3. }\left.\begin{array}{l}\text{A, \$500 for 12 mo.} = \text{\$6000 for 1 mo.}\\ \text{B, \$600 “ 10 “} = \text{\$6000 “ 1 “}\\ \text{C, \$800 “ 6 “} = \text{\$4800 “ 1 “}\end{array}\right\}\text{\$16800.}$$

Then, A's share will be ($\frac{6000}{16800}$ =) $\frac{5}{14}$ of \$700 = \$250; B's $\frac{5}{14}$ of \$700 = \$250; and C's ($\frac{4800}{16800}$ =) $\frac{2}{7}$ of \$700 = \$200, *Ans.*

Banking.

¶ 174. EXAMPLES FOR PRACTICE.

1. $5, int. for 60 days, $2‘50, int. for 30 days, and $‘25, int. for 3 days of grace; $5 + $2‘50 + $‘25 = $7‘75, discount for 90 days and grace at 6 per cent., and $7‘75 + (⅙ of $7‘75 =) $1‘29⅙ = $9‘0416, discount at 7 per cent.; then, $500 — $9‘04⅙ = $490‘95⅚, *Ans.*

2. $3, int. 60 d., $1‘50, int. 30 d., and $‘15, int. 3 d.; then, $3 + $1‘50 + $‘15 = $4‘65, discount at 6 per cent., and $4‘65 — (⅙ of $4‘65 =) $‘775 = $3‘875, *Ans.*

3. $6, int. 60 d., $3, int. 30 d., and $‘30, int. 3 d.; then, $9‘30 + (⅓ of $9‘30 =) $3‘10 = $12‘40, *Ans.*

4. $7‘40, int. 60 d., $3‘70, int. 30 d., and $‘37, int. 3 d., $7‘40 + $3‘70 + $‘37 = $11‘47, discount, and $740 — $11‘47 = $728‘53, *Ans.*

5. $1000 — $15‘50 = $984‘50, the avails of the note; $984‘50 × ‘0155 = $15‘259¾, int. on the avails of the note for 3 mo. 3 d.; and $15‘50 — $15‘259¼ = $‘24+, *Ans.*

Taxes.

¶ 175. 3. $874 + $210 = $1084, value of B’s property; $30 (tax on $1000) + $2‘40 (tax on $80) + $‘12 (tax on $4) + (3 polls at $‘60 each =) $1‘80 = $34‘32, *Ans.*

4. $90 (tax on $3000) + $12 (tax on $400) + $2‘40 (tax on $80) + $‘06 (tax on $2) + $1‘20 (poll tax) = $105‘66. C’s tax; —— $120 (tax on $4000) + $18 (tax on $600) + $2‘10 (tax on $70) + $‘15 (tax on $5) + $‘60 (poll tax) = $140‘85, D’s tax, *Ans.*

Duties.

¶ 177. EXAMPLES FOR PRACTICE.

2. 83 lbs. × 75 = 6225 lbs. gross, which — 597 lbs. tare = 5628 lbs. net; then, $‘04 × 5628 = $225‘12, *Ans.*

3. 420 doz. = 5040, which — (5040 × ‘10 =) 504 = 4536 bottles; then, $‘05½ × 4536 = $249‘48, *Ans.*

4. 10 cwt. 2 qrs. × 8 = 84 cwt. = 9408 lbs. gross, which —(14 lbs. × 84) = 1176 lbs. tare = 8232 lbs. net; then, $‘02¼ × 8232 = $185‘22, *Ans.*

5. 171 lbs. + 125 lbs. + 109 lbs. + 99 lbs. = 504 lbs. gross, which — (4 lbs. draft + 64 lbs. tare =) 68 lbs. = 436 lbs. net; then, $‘06¼ × 436 = $27‘25, *Ans.*

¶ 178. EXAMPLES FOR PRACTICE.

2. 115 lbs. × 40 = 4600 lbs.; $‘11¼ × 4600 = $517‘50, 18 per cent. of which = $93‘15, *Ans.*

3. 33⅓ per cent. = ⅓ of the principal; hence, $256‘80 ÷ 3 = $85‘60, *Ans.*

4. $1‘92 × 140 = $268‘80, which × ‘20 = $53‘76, duty on the whole; $53‘76 ÷ 140 = $‘384, duty on 1 yard; $1‘92 + $‘384 = $2‘304, which + (25 per cent., or ¼ of $2‘304 =) $‘576 = $2‘88, *Ans.*

¶ 179. Review of Percentage.

EXERCISES.

1. $273‘51 × ‘07 = $19‘1457, int. for 1 yr., which ÷ 36 (10 d. = $\frac{1}{36}$ of 1 yr.) = $‘5318+, int. for 10 d.; then, $19‘1457 + $‘5318 = $19‘677+, *Ans.*

2. $486 × ‘08 = $38‘88, int. for 1 yr., which ÷ 4 = $9‘72, int. for 3 mo., and $\frac{19}{20}$ of $9‘72 = $2‘052, int. for 19 d.; then, $38‘88 + $9‘72 + $2‘052 = $50‘652, *Ans.*

5. $2‘29 × ‘008⅙ = $‘0189, int. at 6 per cent., which ÷ 2 = $‘009+, int. at 3 per cent., *Ans.*

6. $18 × ‘07 = $1‘26, int. for 1 yr., which × 2 = $2‘52, int. for 2 yrs.; $1‘26 ÷ 12 = $‘105, int. for 1 mo., and $\frac{7}{15}$ of $‘105 = $‘049, int. for 14 d.; then, $2‘52 + $‘049 = $2‘569, *Ans.*

8. $‘20, int. for 6 d., which ÷ 6 = $‘033⅓, int. for 1 d., and $‘033⅓ × 5 = $‘166+, int. for 5 d., *Ans.*

9. $‘0005 × ‘06 = $‘003, which × 567 = $‘017+, *Ans.*

10. $81 × $‘122⅓ = $9‘909, int. at 6 per cent., which ÷ 6 = $1‘6515, int. at 1 per cent.; $1‘6515 × ½, ¾, ⅝, 2, 3, 4½, 5, 6, 7, 7½, 8, 9, 10, 12, and 12½, respectively, will give the required results.

11. $‘09 × 2‘736⅚ = $‘246+, *Ans.*

12. Whole time 4 yrs. 25 d., which — 1 yr. = 3 yrs. 25 d.; $175 × ‘07 = $12‘25, which × 3 = $36‘75, int. for 3 yrs.; $12‘25 ÷ 12 = $1‘02$\frac{1}{12}$, int. for 1 mo., which × ⅚ = $‘85+, int. for 25 d.; then, $175 + $36‘75 + $‘85 = $212‘60, *Ans.*

13. $56‘75 × ‘025½ (5 mo. 3 d.) = $1‘447+, which + $56‘75 = $58‘197+, *Ans.*

14. Time to payment 2 yrs. 6 mo. 4 d.; $365‘37 × ‘05 = $18‘2685, which × 2 = $36‘537, int. for 2 yrs.; $18‘268 ÷ 2 = $9‘134, int. for 6 mo., which ÷ 45 = $‘203, (nearly,) int. for 4 d.; $97‘16 — $45‘874 = $51‘286; $365‘37

\$51‘286 = \$314‘084, new principal; remaining time 3 mo. 4 d.; \$314‘084 × ‘05 = \$15‘7042, which ÷ 4 = \$3‘92605, int. for 3 mo., which × $\frac{2}{45}$ = \$‘1744+, int. for 4 d.; then, \$314‘084 + \$3‘926 + \$‘174 = \$318‘184, *Ans.*

15. \$203‘17 — \$50 = \$153‘17; \$153‘17 × ‘139½ (2 yrs. 3 mo. 27 d.) = \$21‘367+, which + \$153‘17 = \$174‘537+, *Ans.*

16. Whole time 6 yrs. 10 mo. 6 d.; \$870‘05 × ‘411 = \$357‘59+, which + \$870‘05 = \$1227‘64+, and this sum — \$186‘06 = \$1041‘58+, *Ans.*

17. \$208‘04 (1st payment) — \$48‘712 (int. for 2 yrs. 2 mo. 8 d.) = \$159‘328, and \$317‘92 — \$159‘328 = \$158‘592, remainder for a new principal; \$76 (2d payment) — \$5‘458 (int. 5 mo. 27 d.) = \$70‘542, and \$158‘592 — \$70‘542 = \$88‘05, remainder for a new principal, which + \$4‘982 (int. 9 mo. 21 d.) = \$93‘032, *Ans.*

23. \$422‘40 ÷ \$1‘056 (am't of \$1, at the given rate and time) = \$400, *Ans.*

24. \$426 ÷ \$1‘20167 = \$354‘507+, *Ans.*

25. \$300 ÷ \$1‘045 = \$287‘081+, which — \$250 = \$37‘081+, gain, *Ans.*

26. ½ of \$3120 = \$1560, which ÷ \$1‘015 (3 mo.) = \$1536‘9454+, and \$1560 ÷ \$1‘03 (6 mo.) = \$1514‘563+; then, \$3120 — (\$1536‘9454 + \$1514‘563 =) \$3051‘5084 = \$68‘491+, *Ans.*

27. \$49‘875 ÷ \$‘105 (int. on \$1) = \$475, *Ans.*

28. \$35 ÷ \$‘07 (int. on \$1, at 5 per cent.) = \$500. *Ans.*

29. 15‘50 ÷ \$3‘875 (int. on \$500, 9 mo. 9 d., at 1 per cent.) = ‘04 = 4 per cent., *Ans.*

30. \$‘20 — \$‘167 = \$‘033; then, $\frac{33}{167}$ = ‘1976+ = 19$\frac{76}{100}$ per cent., which is \$19‘76+ on \$100, *Ans.*

31. \$1‘10 × 37 = \$40‘70, (cost,) which — \$40 = \$‘70, (loss;) $\frac{70}{4070}$ = ‘0175 = 1¾ per cent. loss = \$1‘75 on \$100, *Ans.*

32. \$4‘48 × ‘125 = \$‘56, (gain,) which + \$4‘48 = \$5‘04, *Ans.*

33. \$‘92 × 50 = \$46, (cost,) which × ‘10 (10 per cent.) = \$4‘60, (gain,) and this sum + \$46 = \$50‘60; then \$50‘60 ÷ 40 = \$1‘265 per gal., *Ans.*

34. \$950 + \$145 + \$25 = \$1120, (cost,) which × ‘20 (per cent.) = \$224, (gain,) and \$1120 + \$224 = \$1344; then, \$1344 ÷ 22400 (lbs. = 10 tons,) = \$‘06 per lb., *Ans.*

35. First principal, on int. from Dec. 1st, 1841,		$2000
Payment, June 1st, 1842,	$163	
Int to time of 1st payment, (6 mo.,)	60	103
Remainder for a new principal,		$1897
Payment, Feb. 1st, 1843, less than int. then due,	$12	
Payment, Jan. 1st, 1844,	300	
Amount exceeding int. due,	$312	
Int. to time of 3d payment, (1 yr. 7 mo.,)	180‘215	131‘785
Remainder for a new principal,		$1765‘215
Payment, Apr. 1st, 1845, less than int. then due,	$20	
Payment, June 1st, 1845, less than int. then due,	20	
Payment, Aug. 1st, 1845,	400	
Amount exceeding int. due,	$440	
Int. to time of 6th payment, (1 yr. 7 mo.,)	167‘695	272·305
Remainder for a new principal,		$1492·91
Payment, Jan. 1st, 1846,	$100	
Int to time of 7th payment, (5 mo.,)	37‘322	62‘678
Remainder for a new principal,		$1430‘232
Payment, Aug. 1st, 1847,	$150	
Int. to time of 8th payment, (1 yr. 7 mo.,)	135‘872	14‘128
Remainder for a new principal,		$1416‘104
Payment, Oct. 1st, 1847,	$75	
Int. to time of 9th payment, (2 mo.,)	14‘161	60‘839
Remainder for a new principal,		$1355‘265
Int. to Dec. 1st, 1847, (2 mo.,)		13‘552
Balance due Dec. 1st, 1847, by U. S. rules,		$1368‘817+.

2D. BY THE CONNECTICUT RULE.

First principal, on int. from Dec. 1st, 1841,		$2000
Payment, June 1st, 1842,	$163	
Int on payment, (6 mo.,)	4‘89	
Amount of 1st payment,	$167‘89	

Amount brought forward,	$167‘89	$2000
Int. on prin. to Dec. 1st, 1842, (1 yr.,)	120	47‘89
Remainder for a new principal,		$1952‘11
Payment, Feb. 1st, 1843, less than int. then due,	$12	
Payment, Jan. 1st, 1844,	300	
Amount exceeding int. due,	$312	
Int. on prin. to Jan. 1st, 1844, (1 yr. 1 mo.,)	126‘887	185‘113
Remainder for a new principal,		$1766‘997
Payment, Apr. 1st, 1845, less than int. then due,	$20	
Payment, June 1st, 1845, less than int. then due,	20	
Payment, Aug. 1st, 1845,	400	
Amount exceeding int. due,	$440	
Int. on prin. to Aug. 1st, 1845, (1 yr. 7 mo.,)	167‘864	272‘136
Remainder for a new principal,		$1494‘861
Payment, Jan. 1st, 1846,	$100	
Int on payment, (7 mo.,)	3‘50	
Amount of 7th payment,	$10‘350	
Int. on prin. to Aug. 1st, 1846, (1 yr.,)	89‘691	13‘809
Remainder for a new principal,		$1481‘052
Payment, Aug. 1st, 1847,	$150	
Int. on prin. to time of 8th payment, (1 year,)	88‘863	61‘137
Remainder for a new principal,		$1419‘915
Payment, Oct. 1st., 1847,	$75	
Int. on payment, (2 mo.,)	‘75	
Amount of 9th payment,	$75‘75	
Int. on prin. to Dec. 1st, 1847, (4 mo.,)	28‘398	47‘352
Balance due Dec. 1st, 1847,		$1372‘563+.

3d. By the Vermont Rule.

Amount of	$2000	for	6 yrs.,			$2720
" "	$163	for	5 yrs.	6 mo.,	$216‘79	
" "	$12	"	4 "	10 "	$15‘48	
" "	$300	"	3 "	11 "	$370‘50	
" "	$20	"	2 "	8 "	$23‘20	
" "	$20	"	2 "	6 "	$23	
" "	$400	"	2 "	4 "	$456	
" "	$100	"	1 yr.	11 "	$111‘50	
" "	$150	"		4 "	$153	
" "	$75	"		2 "	$75‘75	$1445‘22
Balance due Dec. 1st, 1847,						$1274‘78

EQUATION OF PAYMENTS.

¶ 181. EXAMPLES FOR PRACTICE.

4. $200	for 5 mo.	is the same as $1000	for 1 mo.
$325‘50	" 3 "	" " " " $976‘50	" 1 "
$413‘37	" 2 "	" " " " $826‘74	" 1 "

Then, $2803‘24 ÷ $938‘87 = 2‘985+ months = 2 months and 29+ days, *Ans.*

5. $\overline{\$309{\cdot}50\times 8}+\overline{\$161\times 5\tfrac{3}{5}}+\overline{\$63{\cdot}25\times 10\tfrac{11}{30}}=$ $4033‘291+, which ÷ $533‘75 = 7‘556+ mo. = 7 mo. 16+d., mean time; then, $533‘75 ÷ $1‘037⅔ (am't of $1, for 7 mo. 16 d., at 6 per cent.) = $514‘375+, *Ans.*

6. $\overline{\$50\times 2}+\overline{\$100\times 5}+\overline{\$150\times 8}=$ $1800, which ÷ $300 = 6 months, *Ans.*

7. $\overline{\$136\times 10}+\overline{\$96\times 7}+\overline{\$260\times 4}=$ $3072, which ÷ $492 = 6 mo. 7+ d., *Ans.*

8. $\overline{\$200\times 4}+\overline{\$200\times 8}=$ $2400, which ÷ $600 = 4 mo., *Ans.*

9. $\overline{\$100\times 3}+\overline{\$75\times 4}+\overline{\$125\times 6}=$ $1350, which ÷ $300 = 4½ mo., *Ans.*

PROPORTION.

¶ 191. EXAMPLES FOR PRACTICE.

2. $\overset{2}{\cancel{20}}$ horses : $\overset{3}{\cancel{6}}$: : $\overset{7}{\cancel{70}}$ bushels : ——
$7 \times 3 = 21$ bushels, *Ans.*

5. $(13° 10′ 35″ =)$ 47435″ : (360° =) 1296000″ : : 1 day : ——
$1 \times 1296000 = 1296000$, which ÷ 47435 = 27 days 7 h 43 m. 6 s.+, *Ans.*

6. $145 : $378 : : $12‘63, taxes : $32‘925+, *Ans.*

7. $‘75 : $6 : : 7 lbs. : 56 lbs., *Ans.*

8. $100 : $357‘82 : : $6 : $21‘469+, *Ans.*

9. 6 ft. : 153 ft. : : (5 ft. 8 in. =) 68 in. : (1734 in. =) $144\frac{1}{2}$ ft., *Ans.*

10. $\cancel{10}$ persons : $\overset{3}{\cancel{30}}$ persons : : 3 bu. : 9 bu., *Ans.*

11. $\cancel{2}$ mo. : $\overset{4}{\cancel{8}}$ mo. : : 120 men : 480 men, *Ans.*

12. $\overset{4}{\cancel{24}}$ m. : (10 h. =) $\overset{100}{\cancel{600}}$ m. : 1 pipe : 25 pipes, *Ans.*

13. $\overset{4}{\cancel{16}}|00$ men : $\overset{3}{\cancel{12}}|00$ men : 9 mo. : $6\frac{3}{4}$ mo., *Ans.*

14. $\overset{5}{\cancel{25}}$ rds. long : $\overset{8}{\cancel{40}}$ rds. long : : 4 rds. wide : $6\frac{2}{5}$ rds. wide, *Ans.*

15. $\overset{2}{\cancel{10}}$ h. : $\overset{6}{\cancel{12}}$ h. : : $\overset{3}{\cancel{15}}$ d. : 18d., *Ans.*

16. $\overset{7}{\cancel{21}}$ cows : $\overset{2}{\cancel{6}}$ cows : : $\overset{13}{\cancel{91}}$ days : 26 days, *Ans.*

17. $806 : $292 : : 6 mo. : 2 mo. 5+ d., *Ans.*

18. 7 lb. : 12 lb. : : $\$\frac{3}{4}$: ——
$\$\frac{3}{4} \times 12 = \$\frac{36}{4}$, which ÷ $7 = \frac{36}{28} = \$1\frac{2}{7}$, *Ans.*

19. $(6\frac{1}{2} =) \frac{13}{2}$ yd. : $(9\frac{1}{4} =) \frac{37}{4}$ yd. : : $3 : ——
$\$3 \times \frac{37}{4} = \$\frac{111}{4}$, which ÷ $\frac{13}{2}$ ($\frac{2}{13}$ of $\frac{111}{4}$) $= \$\frac{222}{52} = \$4‘269+$, *Ans.*

20. 2 oz. : ‘75 oz. : : $2‘24 : ——
$2‘24 × ‘75 = $1‘6800, which ÷ 2 = $‘84, *Ans.*

21. $\frac{5}{7}$ oz. : 1 oz. : : $\$\frac{11}{12}$: ——
$\$\frac{11}{12} \times 1 = \$\frac{11}{12}$, which ÷ $\frac{5}{7}$ ($\frac{7}{5}$ of $\frac{11}{12}$) $= \$\frac{77}{60} = \$1‘283+$, *Ans.*

22. $\frac{3}{5}$ yd. : $(40\frac{1}{2} =) \frac{81}{2}$ yd. : : $\$\frac{7}{8}$: ——
$\$\frac{7}{8} \times \frac{81}{2} = \$\frac{567}{16}$, which ÷ $\frac{3}{5}$ ($\frac{5}{3}$ of $\frac{567}{16}$) $= \$\frac{2835}{48} = \$59‘062+$

23. ($\frac{2}{3}$ of $\frac{4}{5}$ =) $\frac{8}{15}$ ves. : 1 ves. : : \$957 : ——
\$957 × 1 = \$957, which ÷ $\frac{8}{15}$ = \$1794'375, *Ans.*

24. (12 A. 3 R. =) 2040 P. : (35 A. 1 R. 20 P. =) 5660 P. : : (78 qrs. 3 pks. =) 2499 pks. : 6933½ pks. = 216 qrs. 5 bu. 1 pk. 4 qts., *Ans.*

NOTE. By cancelation the proportion may become, 34 P. : 283 P. : : 833 pks. : ——

25. $\frac{1}{10}+\frac{1}{20}+\frac{1}{40}+\frac{1}{80}=\frac{15}{80}$ of the cistern in 1 minute; then,
3 16
$\cancel{15}$ eightieths : $\cancel{80}$ eightieths : : 1 minute : 5⅓ minutes, *Ans.*
2 · 89 11
26. $\cancel{6}$ bar. : $\cancel{178}$ bar. : : \$$\cancel{33}$: \$979, *Ans.*
'3
27. $\cancel{2}$'$\cancel{5}$ lbs. : 185 lbs. : : \$'$\cancel{75}$: \$55'50, *Ans.*
28. 1 hhd. : '15 hhd. : : \$2'39 : \$'3585, *Ans.*
29. '15 hhd. : 1 hhd. : : \$'3585 : \$2'39, *Ans.*
30. \$972 : \$11⅓ : : \$607'50 : \$7'083+, *Ans.*
'$\cancel{31}$ 3 3
31. \$$\cancel{1}$'$\cancel{24}$: \$'$\cancel{93}$: : $\cancel{12}$ oz. : 9 oz., *Ans.*

32. 6 oz. × 16 = 96 oz. = 6 lbs., their daily allowance, 224 lbs. ÷ 28 = 8 lbs., to be added to their daily allowance; then, $\cancel{6}$ lbs. : 14 lbs. : : $\cancel{6}$ oz. : 14 oz., *Ans.*

Compound Proportion.

¶ 193. EXAMPLES FOR PRACTICE.

1. 16 days, being of the same kind as the answer required, must be made the 3d term; then,

$$\left.\begin{array}{llcl}
 & \cancel{2} & & \\
 & \cancel{4} & & \\
\textit{Inverse,} & \cancel{24}\text{ men} & : & \cancel{6}\text{ men}\\
 & & & 5\\
 & & & \cancel{10}\\
\textit{Direct,} & \cancel{2}|0\text{ ft. long} & : & \cancel{20}|0\text{ ft. long}\\
 & & & \cancel{2}\\
\textit{Direct,} & \cancel{6}\text{ ft. high} & : & \cancel{8}\text{ ft. high}\\
\textit{Direct,} & \cancel{4}\text{ ft. thick} & : & \cancel{6}\text{ ft. thick}
\end{array}\right\} :: 16\text{ days} : \text{——}$$

Reducing the compound ratio to a simple one, shortening the process by cancelation, we have the simple proportion — 1 : 5 : : 16 days : 80 days, *Ans.*

2. 1200 lbs. × 9 = 10800 lbs., the weight of the hogsheads; and 250 lbs. × 50 = 12500 lbs., the weight of the tierces; then,

$$\left.\begin{array}{ll} \textit{Direct}, & \overset{27}{\cancel{108}}|00 \text{ lbs.} : 125|00 \text{ lbs.} \\ & \qquad\qquad\quad 5 \\ \textit{Direct}, & \cancel{2}|0 \text{ mi.} : \cancel{10}|0 \text{ mi.} \end{array}\right\} : : \$\overset{4}{\cancel{16}} : \text{——}$$

and \$4 × 5 × 125 = \$2500, which ÷ 27 = \$92·592+, *Ans.*

$$\left.\begin{array}{ll} \text{3. } \textit{Direct}, & \cancel{7} \text{ men} : \overset{3}{\cancel{21}} \text{ men} \\ \quad\ \textit{Direct}, & \cancel{14} \text{ days} : 3 \text{ days} \end{array}\right\} : : \overset{4}{\cancel{56}} \text{ lbs.} : \text{——}$$

and 4 lbs. × 3 × 3 = 36 lbs., *Ans.*

$$\left.\begin{array}{ll} & \quad \$\cancel{}·92 \\ & \$\cancel{3}·\cancel{68} \quad \$6·44 \\ \text{4. } \textit{Direct}, & \$\cancel{11}·\cancel{04} : \$\cancel{103}·\cancel{04} \\ \quad\ \textit{Inverse}, & \cancel{16} \text{ d.} : \cancel{3} \text{ d.} \end{array}\right\} : : \cancel{4} \text{ men} : \text{——}$$

and 1 man × 6·44 and the product ÷ ·92 = 7 men, *Ans.*

$$\left.\begin{array}{ll} & \qquad\qquad \cancel{3} \\ \text{5. } \textit{Direct}, & \$·\cancel{06} : \$·\cancel{18} \\ & \quad \cancel{3} \\ \quad\ \textit{Inverse}, & \$·\cancel{9}|0 : \$·76 \end{array}\right\} : : (7 \text{ oz. } 8 \text{ drs.} =) \overset{4}{\cancel{12}}|0 \text{ drs.} : -$$

and 4 drs. × 76 = 304 drs. = 1 lb. 3 oz., *Ans.*

$$\left.\begin{array}{ll} \text{6. } \textit{Direct}, & \text{Prin. } \$1|00 : \$\cancel{4}|00 \\ & \qquad\qquad \cancel{3} \quad\ 3 \\ \quad\ \textit{Direct}, & \text{Time, } \cancel{12} \text{ mo.} : \cancel{9} \text{ mo.} \end{array}\right\} : : \$6 \text{ int.} : \$18 \text{ int., } \textit{Ans.}$$

$$\left.\begin{array}{ll} \text{7. } \textit{Inverse}, & \text{Prin. } \$\cancel{4}|00 : \$1|00 \\ & \qquad\qquad\qquad\quad 3 \\ \quad\ \textit{Direct}, & \text{Int. } \$\cancel{6} : \$\cancel{18} \end{array}\right\} : : \overset{3}{\cancel{12}} \text{ mo.} : 9 \text{ mo., } \textit{Ans}$$

$$\left.\begin{array}{ll} \text{8. } \textit{Direct}, & \text{Prin. } \cancel{4}\$|00 : \$1|00 \\ \quad\ \textit{Direct}, & \text{Time, } \cancel{9} \text{ mo} : \$\cancel{12} \text{ mo.} \\ & \qquad\qquad\qquad 3 \end{array}\right\} : : \$\overset{2}{\cancel{18}} \text{ int.} : \$6 \text{ int., } \textit{Ans.}$$

$$\left.\begin{array}{ll} & \qquad\quad \cancel{3} \qquad 4 \\ \text{9. } \textit{Inverse}, & \text{Time, } \cancel{9} \text{ mo.} : \cancel{12} \text{ mo.} \\ & \qquad\qquad\qquad\quad \cancel{3} \\ \quad\ \textit{Direct}, & \text{Int. } \$\cancel{6} : \$\cancel{18} \end{array}\right\} : : \$100 \text{ prin.} : \$400 \text{ prin., } \textit{Ans.}$$

$$\left.\begin{array}{ll} & \qquad\quad \cancel{3} \qquad \cancel{4} \\ \text{10. } \textit{Direct}, & \text{Prin. } \$\cancel{75} : \$\cancel{100} \\ & \qquad\qquad\qquad 2 \\ & \qquad\quad \cancel{2} \qquad \cancel{4} \\ \quad\ \textit{Direct}, & \text{Time, } \cancel{8} \text{ mo. } \cancel{12} \text{ mo.} \end{array}\right\} : : \$4 \text{ int.} : \$8 \text{ int.} = 8 \text{ per cent., } \textit{Ans.}$$

¶ 194. Review of Proportion.

EXERCISES.

1. 76 yds. × 4 = 304 qrs., which ÷ 5 = 60·8 E. E.; then,
0·8 E. E. : 1 E. E. : : \$113·17 : \$1·861+, *Ans.*
E. E. × 4 = 96 E. E. = 120 yds.; then,

$\overset{5}{\cancel{120}}$ yds. : 1 yd. :: $\$\overset{4}{\cancel{96}}$: $\$\text{‘}80$, *Ans.*

3. *Inverse*, $\overset{1\text{‘}9}{\cancel{9\text{‘}5}}$ mo. : 8 mo. :: $\overset{3}{\cancel{15}}$ oz. : 12$\frac{12}{19}$ oz., *Ans.*

4. $\$\cancel{2\text{‘}5}|0$: $\$\overset{15}{\cancel{3\text{‘}75}}$ :: 36|0 acres : 540 acres, *Ans.*

5. *Inverse*, $\overset{52}{\cancel{208}}$ d. : $\overset{57}{\cancel{228}}$ d. :: 185 qrs. : 202$\frac{41}{52}$ qrs., *Ans.*

6. ($\frac{3}{4}$ of $\frac{3}{5}$ =) $\frac{9}{20}$ mine : 1 mine :: 171£. : 380£., *Ans.*

7. $\frac{5}{\cancel{9}}$ T. $\frac{4}{1}\times\frac{\overset{7}{\cancel{63}}}{1}$ = 140 gal.; then, $\frac{5}{8}$ gal. : 140 gal. :: $\$\frac{5}{8}$: $140, *Ans.*; or, the first and third terms being the same number, they may be dropped, and the second term taken to express the answer, thus, $140, as before.

8. 1 cwt. = 112 lbs., 3$\frac{1}{3}$ lbs. = $\frac{10}{3}$ lb., and 1$\frac{1}{2}$£. = $\frac{3}{2}$£.; then, 112 lbs. : $\frac{10}{3}$ lb. :: $\frac{3}{2}$£. : $\frac{5}{112}$£. = 10$\frac{5}{7}$ d., *Ans.*

9. $\overset{5}{\cancel{20}}$ mi. : $\overset{9}{\cancel{36}}$ mi. :: (4$\frac{1}{2}$ cwt. =) 504 lbs. : 907$\frac{1}{5}$ lbs., *Ans.*

10. 24 h. : 1 h. :: 360° : 15°, *Ans.*; 60 m. : 1 m. :: 15° : 4′, *Ans.*; 60 s. : 1 s. :: 4′ : 15″, *Ans.*

$$11.\ \left.\begin{array}{lcl}\textit{Direct},\ \cancel{9}\ \text{persons} & : & 14\ \text{persons}\\ \textit{Direct},\ \cancel{5}\ \text{mo.} & : & 8\ \text{mo.}\end{array}\right\} :: \overset{\overset{10}{\cancel{50}}}{\$\cancel{450}} : \$1120,\ \textit{Ans.}$$

ALLIGATION — Medial.

¶ 195. EXAMPLES FOR PRACTICE.

2. 5 lbs. at 10 cts. cost 50 cts.
8 " " 12 " " 96 "
20 " " 14 " " 280 " $\frac{426}{33}$ = 12$\frac{10}{11}$ cts., *Ans.*
33 lbs. 426 cts.

3. 3 oz. 20 carats = 60 carats.
5 " 22 " = 110 " $\frac{170}{8}$ = 21$\frac{1}{4}$ carats, *Ans.*
8 oz. 170 carats.

4. 40 gals. at 42 cts. cost 1680 cts.
6 " " 0 " " 0 " $\frac{1680}{46}$ = 36$\frac{12}{23}$ cts., *Ans.*
46 gals. 1680 cts.

5. 5 h. at 64° = 320°
4 h. " 70° = 280°
2 h. " 75° = 150° $\frac{969}{14} = 69\frac{3}{14}$ deg., *Ans*
3 h. " 73° = 219°
14 h. 969°

6. 16 A. at $90, cost $1440
22 " " $75 " $1650
18 " " $64 " $1152
10 " " $55 " $ 550
30 " " $36 " $1080 \$$\frac{6922}{138}$ = $50·159+, *Ans.*
42 " " $25 " $1050
138 A. $6922

7. 3 cows at $35 cost $105
4 " " $30 " $120
6 " " $24 " $144
4 " " $20 " $ 80 \$$\frac{498}{20}$ = $24·90, *Ans.*
2 " " $18 " $ 36
1 " " $13 " $ 13
20 cows. $498

Alligation Alternate.

¶ 197. EXAMPLES FOR PRACTICE.

8 cts. 2 lbs. = 2 lbs. of the 1st kind.
1. 12 cts. 10 cts. 2 lbs. = 2 lbs. " " 2d kind.
14 cts. 4 lbs. + 2 lbs. = 6 lbs. 3d kind.

7 cts. 2 lbs. = 2 lbs. of the 1st kind.
2. 10 cts. 9 cts. 2 lbs. = 2 lbs. " " 2d kind.
12 cts. 3 lbs. + 1 lb. = 4 lbs. 3d kind.

3. The proportions of the 1st and 2d kinds are alike. To find what will be the proportion of the 3d kind, using
1 lb. of 1st kind, 2 lbs. : 1 lb. : : 4 lbs. : 2 lbs. of 3d kind
4 lbs. " " " 2 lbs. : 4 lbs. : : 4 lbs. : 8 lbs. " " "
6 lbs. " " " 2 lbs. : 6 lbs. : : 4 lbs. : 12 lbs. " " "
10 lbs. " " " 2 lbs. : 10 lbs. : : 4 lbs. : 20 lbs. " " "
20 lbs. " " " 2 lbs. : 20 lbs. : : 4 lbs. : 40 lbs. " " "

16d. 8 lbs. = 8 lbs. Proportions
4. 24d. 20d. 8 lbs. = 8 lbs. alike.
32d. 8 lbs. + 4 lbs. = 12 lbs.

8 lbs. : 5 lbs. : : 12 lbs. : 7½ lbs. of the 3d kind to be taken with 5 lbs. of the 1st and 2d kinds.

5. 70 cts. { 0 — 10 gal., proportional quantity of water.
{ 80 — 70 gal., proportional quantity of rum.

70 gal. rum : 60 gal. rum : : 10 gal. water : 8$\frac{4}{7}$ gal. water *Ans.*

6. 84 cts. { \$1'50 — 34 bu. proportional quant. wheat.
{ \$1'16 — 9 bu. " " rye.
{ \$ '75 — 32 bu. " " corn.
{ \$ '50 — 66 bu. " " barley.

34 bu. wheat : 4 bu. wheat : : 9 bu. rye : 1$\frac{1}{17}$ bu. rye,
34 " " : 4 " " : : 32 " corn : 3$\frac{13}{17}$ " corn,
34 " " : 4 " " : : 66 " bar. : 7$\frac{13}{17}$ " barley, } *Ans.*

7. 22 { 17 — 2 = 2 parts of the 1st kind,
{ 19 — 2 = 2 parts of the 2d kind,
{ 21 — 2 = 2 parts of the 3d kind,
{ 24 — 5 + 3 + 1 = 9 parts of the 4th kind, } *Ans.*

8. The proportions of the first 3 kinds are alike. 2 oz. : 1 oz. : : 9 oz. : 4$\frac{1}{2}$ oz., (of the 4th kind,) which + 1 + 1 + 1 = 7$\frac{1}{2}$ oz. of the mixture, *Ans.*

9. 7$\frac{1}{2}$ oz. (compound in the last ex.) = $\frac{15}{2}$ oz.

15 oz. mixture. { $\frac{15}{2}$ oz. : 15 oz. : : 1 oz. : 2 oz. of 1st 3 kinds,
{ $\frac{15}{2}$ oz. : 15 oz. : : (4$\frac{1}{2}$ =) $\frac{9}{2}$ oz. : 9 oz. 4th kind,
30 oz. mixture. { $\frac{15}{2}$ oz. : 30 oz. : : 1 oz. : 4 oz. 1st 3 kinds,
{ $\frac{15}{2}$ oz. : 30 oz. : : 4$\frac{1}{2}$ oz. : 18 oz. 4th kind, } *Ans.*

10. 12 cts. { 8 cts. — 2 lbs. prop. quan. 1st. kind,
{ 10 cts. — 2 lbs. " " 2d. "
{ 14 cts. — 4 lbs. + 2 lbs. = 6 lbs. " " 3d. "

2 lbs. + 2 lbs. + 6 lbs. = 10 lbs., amount of the proportional quantities. The proportions of the 1st and 2d kinds are alike; then,

10 lbs. : 100 lbs. : : 2 lbs. : 20 lbs., of 1st and 2d kinds,
10 lbs. : 100 lbs. : : 6 lbs. : 60 lbs., of 3d kind, } *Ans.*

11. 8d. { 4d. — 3
{ 6d. — 1
{ 9d. — 2
{ 11d. — 4 } 10, sum of the proportional quantities.

As { 10 : 240 : : 3 lbs. : 72 lbs. at 4d.
{ 10 : 240 : : 1 lb. : 24 lbs. at 6d.
{ 10 : 240 : : 2 lbs. : 48 lbs. at 9d.
{ 10 : 240 : : 4 lbs. : 96 lbs. at 11d. } *Ans.*

EXCHANGE.

¶ 200. Exchange with England.

1. $\$4‘44\frac{4}{9} \times 5000 = \$22222‘22\frac{2}{9}$, (the nominal value of 5000£. sterling,) which + ($9\frac{1}{2}$ per cent. of the nominal value =) $\$2111‘1109\frac{1}{9} = \$24333‘333+$, *Ans.*

2. $\$4‘44\frac{4}{9} \times 7000 = \$31111‘11\frac{1}{9}$, (the nominal value;) he sold the bill for ($11 - 9\frac{1}{2} =$) $1\frac{1}{2}$ per cent. of its nominal value more than its par value; $\$31111,11\frac{1}{9} \times ‘015 = \$466‘66\frac{2}{3}$, *Ans.*

3. $\$4‘44\frac{4}{9} \times 4000 = \$17777‘77\frac{7}{9}$, (nominal value,) which $+\$1688‘8881\frac{8}{9}$ ($9\frac{1}{2}$ per cent. of itself) $= \$19466‘6659\frac{2}{3}$, (par value;) and $\$19466‘6659\frac{2}{3} - \$389‘333319\frac{1}{3}$ (= 2 per cent. of par value, expense of transportation) = $19077,3326+, what he would have realized for the bill, had he imported the specie; $\$17777‘77\frac{7}{9}$ (nominal value) $+ \$1422‘22\frac{2}{9}$ (= 8 per cent. of the nominal value) = $19200, avails of the bill; then, $19200 — $19077‘3326 = $122‘667+, amount saved, *Ans.*

4. $\$4‘44\frac{4}{9} \times 2000 = 8888‘88\frac{8}{9}$, (nominal value,) which $+ \$844‘44\frac{4}{9}$ ($9\frac{1}{2}$ per cent. of nominal value) $= \$9733‘33\frac{1}{3}$, real value, $\frac{1}{10}$ per cent of which $= \$9‘73\frac{1}{3}$, commission on the real value of the bill; $\$8888‘88\frac{8}{9} + \$888‘88\frac{8}{9}$ (10 per cent. of nominal value) $= \$9777‘77\frac{7}{9}$, avails of the bill, which $- \$9733‘33\frac{1}{3}$ (real value) $= \$44‘44\frac{4}{9}$, which $\times ‘05 = \$2‘22\frac{2}{9}$, commission on $\$44‘44\frac{4}{9}$; then, $\$9‘73\frac{1}{3} + \$2‘22\frac{2}{9} = \$11‘95\frac{5}{9}$, *Ans.*

¶ 201. Exchange with France.

1. $‘186 (= 1 franc) × 5‘4 = $1‘0044, the amount received on each dollar; $‘0044 (gain on $1) × 2500 (= number of dollars) = $11, *Ans.*

2. $‘186 (= 1 franc) × 5‘31 = $‘98766, amount received on $1, and $1 — $‘98766 = $‘01234, loss on $1; then, $‘01234 × 2800 (= number of dollars) = $34‘552, less than the value of the bill, *Ans.*

DUODECIMALS.

Multiplication of Duodecimals.

¶ 204. EXAMPLES FOR PRACTICE.

3. 12 ft. 8′ × 1 ft. 1′ = 13 ft. 8′ 8″, which × 15 = 205 ft.

4.

	371 ft.	2′	6″	‴	⁗
	181	1	9		
6″ × 9″ =				4	6
2′ × 9″ =			1	6	
371 ft. × 9″ =	23	2	3		
6″ × 1′ =				6	
2′ × 1′ =			2		
371 ft. × 1′ =	30	11			
6″ × 181 ft. =	7	6	6		
2′ × 181 ft. =	30	2			
371 ft. × 181 ft. =	67151				
	67242	10	1	4	6, *Ans.*

5. 47 ft. 3′ × 7 ft. 6′ = 39 sq. yds. 3 sq. ft. 4′ 6″.

6. 26 ft. 8′ × 24 ft. 9′ = 660 sq. ft. = $73\frac{1}{3}$ sq. yds.; then, $‘90 × $73\frac{1}{3}$ = $66, *Ans.*

7. 15 ft. 4′ × 16 ft. × 2 = 490 ft. 8 in., 10 ft. 6′ × 24 ft. = 252 ft., 11 ft. 4′ × 8 ft. × 3 = 272 ft., 9 ft. 6′ × 7 ft. = 66 ft. 6′, 14 ft. 2′ × 18 = 255 ft., 20 ft. 8′ × 16 × 2 = 661 ft. 4′, which amounts added together = 1997 ft. 6′; then, $‘02 × $1997\frac{1}{2}$ = $39‘95, *Ans.*

8. 32 ft. 6′ + 32 ft. 6′ (side walls) + 21 ft. 6′ + 21 ft. 6′ (end walls, deducting the corners) = 108 ft., (length of the walls,) which × 7 ft. (hight) = 756 sq. ft.; then, 756 sq. ft. ÷ $16\frac{1}{2}$ = $45\frac{9}{11}$ perches of stone in the walls. 32 ft. 6′ + 32 ft. 6′ + 24 ft. 6′ + 24 ft. 6′ = 114 ft., (girt of the walls,) which × 7 = 798 sq. ft.; then, 798 sq. ft. ÷ $16\frac{1}{2}$ = $48\frac{4}{11}$ perches, the mason must be paid for, *Ans.*

9. 7 ft. × 3 ft. × 3 ft. 4′ = 70 cu. ft., which ÷ 16 = $4\frac{3}{8}$ C. ft.; $‘40 × $4\frac{3}{8}$ = $1‘75, *Ans.*

10. $1‘92 a cord is $‘24 a cord foot; 10 ft. × 3 ft. 9′ × 4 8′ = 175 cu. ft. = 1 C. $2\frac{15}{16}$ C. ft.; $‘24 × $2\frac{15}{16}$ = $‘$70\frac{1}{2}$, cost of $2\frac{15}{16}$ C. ft., which + $1‘92 (cost of 1 cord) = $2‘$62\frac{1}{2}$, *Ans.*

¶ 205. 1. 4‘5 ft. × 2‘6 ft. = 11‘7 cu. ft.; $‘75 × 11‘7 = $8‘775, *Ans.*

2. 7‘5 ft. × 3‘6 ft. × 4‘8 ft. = 129‘6 cu. ft. = 1 C. $1\frac{6}{10}$ cu. ft., *Ans.*

3. 10 ft. × 3‘4 ft. × 3‘5 ft. = 119 cu. ft. = $7\frac{7}{16}$ C. ft., *Ans.*

EXTRACTION OF THE SQUARE ROOT.

¶ 209. EXAMPLES FOR PRACTICE.

$\dot{4}3\dot{2}6\dot{4}$ (208, *Ans.*
4
408) 3264
3264

4. $9\dot{9}8\dot{0}0\dot{1}$ (999, *Ans.*
81
189) 1880
1701
1989) 17901
17901

5. $\dot{2}3\dot{4}{\cdot}0\dot{9}$ (15‘3, *Ans.*
1
25) 134
125
303) 909
909

6. $\dot{9}6\dot{4}{\cdot}5\dot{1}9\dot{2}3\dot{6}0\dot{2}4\dot{1}$ (31‘05671, *Ans.*
9
61) 64
61
6205) 35192
31025
62106) 416736
372636
621127) 4410002
4347889
6211341) 6211341
6211341

7. $\cdot 0\dot{0}1\dot{2}9\dot{6}$ (‘036, *Ans.*
9
66) 396
396

8. $\cdot 2\dot{9}1\dot{6}$ (‘54, *Ans.*
25
104) 416
416

9. $3\dot{6}3\dot{7}2\dot{9}6\dot{1}$ (6031, *Ans.*
36
1203) 3729
3609
12061) 12061
12061

10. $\dot{1}6\dot{4}$ (12‘8+, *Ans.*
1
22) 064
44
248) 2000
1984
16

11. $\dot{3}$ (1·73+, *Ans.*
1
27) 200
189
343) 1100
1029
71

12. $1\dot{0}$ (3·16+, *Ans.*
9
61) 100
61
626) 3900
3756
144

13. $\dot{1}8\dot{4}{\cdot}2\dot{0}$ (1357+, *Ans.*
1
23) 84
69
265) 1520
1325
2707) 19500
18949
551

14. $\dot{4}$ Num. (2
4
$\dot{9}$ Denom. (3.
9
$= \frac{2}{3}$, *Ans.*

15. $\dot{4}$ Num. (2
4
$2\dot{5}$ Denom. (5
25
$= \frac{2}{5}$, *Ans.*

16. $1\dot{6}$ Num. (4
16
$\dot{1}0\dot{0}$ Denom. (10
1
00
$= \frac{4}{10}$, *Ans.*

17. $8\dot{1}$ Num. (9
81
$\dot{1}4\dot{4}$ Denom. (12
1
22) 44
44
$= \frac{9}{12}$, *Ans.*

18. $2\dot{0}{\cdot}2\dot{5}$ (4·5, *Ans.*
16
85) 425
425

19. ·$7\dot{5}$ (·866+, *Ans.*
64
166) 1100
996
1726) 10400
10356
44

20. $\frac{35}{42}$ = ‘$8\dot{3}3\dot{3}3\dot{3}$ (‘912+, *Ans.*
81
181) 233
181
1822) 5233
3644
1589

¶ 210. Practical Exercises in the Extraction of the Square Root.

1. $4\dot{0}9\dot{6}$ ($\overset{\text{men.}}{64}$, *A.*
36
124) 496
496

2. $2\dot{0}2\dot{5}$ ($\overset{\text{rods.}}{45}$, *A.*
16
85) 425
425

3. $5\dot{6}2\dot{5}$ ($\overset{\text{trees.}}{75}$, *A.*
49
145) 725
725

4. $5\dot{1}8\dot{4}$ (72 ft., *A.*
49
142) 284
284

5. 40 A. + 50 A. = 90 A., which × 160 (rods in 1 A.) = $\dot{1}4\dot{4}0\dot{0}$ P. (120 P., *A.*
1
22) 44
44
00

7. $\sqrt{5\text{ ft.}\times 5\text{ ft. }4}$ = 10 ft., &c., *Ans.*

8. ½ of 288 P. = 144 P., and $\sqrt{144}$ = 12 rds. square. Two such fields, laid side by side, form a parallelogram 24 rods in length and 12 rods in breadth, *Ans.*

9. ¼ of 784 = $\sqrt{196}$ = 14 rows of trees each way, and 4 such, laid side by side, would form an orchard of 14 rows and (14 × 4 =) 56 trees in a row, *Ans.*

10. ¾ of 192 = $\sqrt{144}$ = 12 rods square. The other 48 rods (¼ of 192) will extend this field on one side (48 ÷ 12 =) 4 rods, forming a field 12 rods in breadth and 16 rods in length, *Ans.*

12. $\sqrt{100\times 100\times 3}$ = 173‘2 + feet, *Ans.*

13. $\sqrt{12\times 12\div 4}$ = 6 inches, *Ans.*

15. $6^2 = 36$, and $8^2 = 64$; then, $\sqrt{36+64}$ = 10 feet, *Ans.*

16. $32^2 = 1024$, and $24^2 = 576$; then, $\sqrt{1024+576}$ feet, *Ans.*

17. $40^2 = 1600$, and $32^2 = 1024$; then, $\sqrt{1600 - 1024} = 24$ feet, *Ans.*

18. 40^2 (length of the ladder) $= 1600$, and 24^2 (width of the ditch) $= 576$; then, $\sqrt{1600 - 576} = 32$ feet, *Ans.*

19. By the question, each rafter becomes the hypotenuse of a right-angled triangle, with a perpendicular (12 feet) common to both. One half of the beam (16 feet) is base to the one, and the other half base to the other. $12^2 = 144$, and $16^2 = 256$; then, $\sqrt{144 + 256} = 20$ feet, *Ans.*

20. The projection of the eaves 1 foot each way will make the length of the roof 32 feet, and the breadth 24 feet. A diagonal line, extending from corner to corner, will be the hypotenuse of a horizontal right-angled triangle, of which the length and the breadth of the roof will form the two sides. Half the length of this line will be the distance from the post to the corners of the eaves. $32^2 = 1024$, and $24^2 = 576$; then, $\sqrt{1024 + 576} = 40$ ft.; the half of which, 20 ft., is the distance from the posts to the corners of the eaves. Length of a rafter to the middle of one side, $10^2 = 100$, and $12^2 = 144$; then, $\sqrt{100 + 144} =$ 15‘62+ feet, *Ans.* —— rafter reaching to the middle of one end, $10^2 = 100$, and $16^2 = 256$; then, $\sqrt{100 + 256} =$ 18‘86+, *Ans.* —— rafter reaching to the corners of the eaves, $10^2 = 100$, and $20^2 = 400$; then, $\sqrt{100 + 400} =$ 22‘36+ feet, *Ans.*

21. $800^2 = 640000$, and $600^2 = 360000$; then, $\sqrt{640000 + 360000} = 1000$ rods between the corners, *Ans.*

22. $\sqrt{90 \times 160} = 120$ rods each side; $\sqrt{120^2 \times 2} =$ 169‘7+ rods from corner to corner, *Ans.*

23. $\sqrt{10 \times 160} = 40$ rods each side of the field, and $\sqrt{40^2 \times 2} =$ 56‘56+ rods, which $\div 2 =$ 28‘28+ rods, distance of the centre from each corner, *Ans.*

Extraction of the Cube Root.

¶212. EXAMPLES FOR PRACTICE.

5.

$$\begin{array}{rl}
 & 37\dot{3}24\dot{8}\ (\ 72,\ \textit{Ans.} \\
 & 343 \\
70^2 \times 3 = 14700\ ) & \overline{30248} \\
14700 \times 2 = & \overline{29400} \\
2^2 \times 70 \times 3 = & 840 \\
2 \times 2 \times 2 = & 8 \\
 & \overline{30248} \\
 & \overline{00000}
\end{array}$$

6. $2\dot{1}02\dot{4}57\dot{6}$ (276, *Ans.*
$2 \times 2 \times 2 = 8$
$20^2 \times 3 = 1200$) 13024, 2d dividend.
$1200 \times 7 = 8400$
$7^2 \times 20 \times 3 = 2940$
$7 \times 7 \times 7 = 343$
11683
$270^2 \times 3 = 218700$) 1341576, 3d dividend.
$218700 \times 6 = 1312200$
$6^2 \times 270 \times 3 = 29160$
$6 \times 6 \times 6 = 216$
1341576
0000000

7. $8\dot{4}{\cdot}60\dot{4}51\dot{9}$ (4·39, *Ans.*
$4 \times 4 \times 4 = 64$
$40^2 \times 3 = 4800$) 20604
$4800 \times 3 = 14400$
$3^2 \times 40 \times 3 = 1080$
$3 \times 3 \times 3 = 27$
15507
$430^2 \times 3 = 554700$) 5097519
$554700 \times 9 = 4992300$
$9^2 \times 430 \times 3 = 104490$
$9 \times 9 \times 9 = 729$
5097519
0000000

8. ·00$\dot{0}$34$\dot{3}$ (·07, *A.*
000
343
7 × 7 × 7 × 343
000

9. $\dot{2}$ (1·25+, *A.*
1 × 1 × 1 = 1
10^2 × 3 = 300) 1000
300 × 2 = 600
2^2 × 10 × 3 = 120
2 × 2 × 2 = 8
728
120^2 × 3 = 43200) 272000
43200 × 5 = 216000
5^2 × 120 × 3 = 9000
5 × 5 × 5 = 125
225125
46875

10. $\dot{8}$ (2
2 × 2 × 2 = 8
2$\dot{7}$ (3
3 × 3 × 3 = 27
$= \frac{2}{3}$, *A.*

11. 12$\dot{5}$ (5
5 × 5 × 5 = 125
21$\dot{6}$ (6
6 × 6 × 6 = 216
$= \frac{5}{6}$, *Ans.*

12. 34$\dot{3}$ (7
7 × 7 × 7 = 343
$\dot{1}$72$\dot{8}$ (12
1
10^2 × 3 = 300) 728
300 × 2 = 600
2^2 × 10 × 3 = 120
2 × 2 × 2 = 8
728
000
$= \frac{7}{12}$, *Ans.*

13. $\frac{1}{500}$ = ·$\dot{2}$ (·125+, *Ans.*
1
10^2 × 3 = 300) 1000
300 × 2 = 600
2^2 × 10 × 3 = 120
2 × 2 × 2 = 8
728

Carried forward

$120^2 \times 3 = 43200$) 272000 *Brought forward.*

43200 × 5 = 216000
$5^2 \times 120 \times 3 =$ 9000
5 × 5 × 5 = 125

225125

46875

14. $\dot{1}$ (1
1
$12\dot{5}$ (5 $= \frac{1}{5}$, *Ans.*
5 × 5 × 5 = 125

¶ 213. Practical Exercises in Extracting the Cube Root.

1. 288 × 216 × 48 = $\dot{2}98\dot{5}98\dot{4}$ (144 ft., *Ans.*
1

$10^2 \times 3 = 300$) 1985

300 × 4 = 1200
$4^2 \times 10 \times 3 =$ 480
4 × 4 × 4 = 64

1744

$140^2 \times 3 = 58800$) 241984

58800 × 4 = 235200
$4^2 \times 140 \times 3 =$ 6720
4 × 4 × 4 = 64

241984

000000

2. 2 × 2 × 2 = 8 ft., *Ans.*

3. 8 ft. × 8 (times) = $6\dot{4}$ (solid ft.) 4 ft. = one side, *Ans.*
4 × 4 × 4 = 64

4. 5 × 5 × 5 = 125, which × 27 =
$\dot{3}37\dot{5}$ (15 ft. = one side, &c.
1

$10^2 \times 3 = 300$) 2375

300 × 5 = 1500
$5^2 \times 10 \times 3 =$ 750
5 × 5 × 5 = 125

2375

0000

5. $1^3 = 1$, which × 8 (times) $= \dot{8}$ (2 ft., *Ans.*
$2 \times 2 \times 2 = 8$

Or, ——— $2\dot{7}$ (3 ft., *Ans.*
$3 \times 3 \times 3 = 27$

Or, ——— $6\dot{4}$ (4 ft., *Ans.*
$4 \times 4 \times 4 = 64$

6. $4 : 32 :: (3^3 =)\ 27 : 21\dot{6}$ (6 in., *Ans.*
$6 \times 6 \times 6 = 216$

7. $(6^3 =)\ 216 : (3^3 =)\ 27 :: 32$ lb. : 4 lb., *Ans.*

8. 1^3 in. = 1 in., and (1 ft. =) 12^3 in. = 1728 in. diam.; then, 1 in. : 1728 in. : : \$6 : \$10368, *Ans.*

9. $(40^3 =)\ 64000 \div (1^3 =)\ 1 = 64000$ of the smaller, *Ans.*

10. $112^3 = 1404928$ globes, large as the earth, to make one large as the sun, *Ans.*

11. 7900^3 (the earth's diam.) = 493039000000, which ×
$1000 = 49\dot{3}03\dot{9}00\dot{0}00\dot{0}00\dot{0}$ (79000 miles, diam. of Saturn, *Ans.*
$7^3 = 343$

$70^2 \times 3 = 14700$) 150039

$14700 \times 9 = 132300$
$9^2 \times 70 \times 3 = 17010$
$9^3 = 729$

150039

000000

12. $\left.\begin{array}{l} 2^3 = 8 \\ 9^3 = 729 \end{array}\right\} = \frac{8}{729}$, or as 8 to 729, *Ans.*

¶214. Review of Involution and Evolution.

EXERCISES.

1. 20 rds. × 20 rds. = 400 P., which × 6 = 2400 P., and 50 rds. × 50 rds. = 2500 P.; then, 2500 P. — 2400 P. = 100 P., *Ans.*

2. 10^3 ft. = 1000 cu. ft. in 1 stack, which × 56 = 56000 cu. ft. in 56 stacks of the 1st size, and 40^3 ft. = 64000 cu. ft. in 1 stack of the 2d size; then, 64000 cu. ft. — 56000 cu. ft. = 8000 cu. ft., *Ans.*

3. (1 mi. =) 320^2 rds. = 102400, and 40^2 rds. = 1600; then, $102400 \div 1600 = 64$ times, *Ans.*

4. 128 cu. ft. (= 1 C.) × 4 = 512 cu. ft., and $\sqrt[3]{512}$ cu. ft. = 8 ft., length of one side, *Ans.*

5. The side walls will each be 60 ft. long the whole hight; the end walls will each be 31 ft. 4 in. long, the 1st 12 ft., 32 ft. long the next 12, and 32 ft. 8 in. the next 12. 120 ft. +

62⅔ ft. = 182⅔ ft., (length of the walls first 12 ft.,) which × 1⅓ ft. (thickness) × 12 ft. (hight) = 2922⅔ cu. ft., contents of the walls 12 ft. high; 120 ft. + 64 ft. = 184 ft., (length of the walls next 12 ft.,) which × 1 ft. (thickness) × 12 ft. (hight) = 2208 cu. ft., contents of the walls next 12 ft. high; 120 ft. + 65⅓ ft. = 185⅓ ft., (length of the walls last 12 ft.,) which × ⅔ ft. (thickness) × 12 ft. (hight) = 1482⅔ cu. ft., contents of the walls last 12 ft. high; then, 2922⅔ cu. ft. + 2208 cu. ft. + 1482⅔ cu. ft. = 6613⅓ cu ft., solid contents of the walls; and $\sqrt[3]{\text{6613‘333333+ cu. ft.}}$ = 18‘77+ ft., length of one side of the cubical pile of bricks, *Ans.*

ARITHMETICAL PROGRESSION.

¶ 216. EXAMPLES FOR PRACTICE.

2. 23 − 1 = 22, which × 4 = 88, sum of the subtractions, and 95 − 88 = 7, *Ans.*

3. 57 − 1 = 56, which × 3 = 168, sum of the additions, and 168 + 6 = 174, *Ans.*

4. 15 − 1 = 14, which × 8 = 112, sum of the subtractions, and 117 − 112 = 5, *Ans.*

5. 21 − 1 = 20, which × 10 = 200, and 200 + 6 = 206, *Ans.*

¶ 217. Simple Interest by Progression.

2. Here 50 is the number of terms less one, $‘07 × 300 = $21 the common difference, and $300 the first term; then, $21 × 50 = $1050, sum of the additions, which + $300 = $1350, *Ans.*

3. The first term is $25, $‘08 × 25 = $2 the common difference, and 54 the number of terms less one; then, $2 × 54 = $108, which + $25 = $133, *Ans.*

¶ 218. *The extremes and the number of terms given, to find the common difference.*

EXAMPLES FOR PRACTICE.

2. 605 − 5 = 600, which ÷ (151 − 1 =) 150 = 4, *Ans.*

3. 45 − 10 = 35, which ÷ (8 − 1 =) 7 = 5, *Ans.*

4. 1205 − 5 = 1200, which ÷ 8 = 150, and 150 + 1 = 151, *Ans.*

¶ 219. *The extremes and the number of terms given, to find the sum of all the terms.*

EXAMPLES FOR PRACTICE.

2. 605 + 5 = 610, which × 151 = 92110, and 92110 ÷ 2 = 46055, *Ans.*

3. 100 + 1 = 101, which × 100 = 10100, and $\frac{10100}{2}$ = 5050, *Ans.*

4. 12 + 1 = 13, which × 12 = 156, and $\frac{156}{2}$ = 78, *Ans.*

¶ 220. Annuities by Arithmetical Progression.

EXAMPLES FOR PRACTICE.

2. \$147‘84 (amount of \$96 for 9 years) + \$96 = \$243‘84, which × 10 = \$2438‘40, and $\frac{\$2438‘40}{2}$ = \$1219‘20, *Ans.*

3. Whole number of years, 61. \$26 (amount of \$5 for 60 years) + \$5 = \$31, which × 61 = \$1891; \$1891 ÷ 2 = \$945‘50, which + \$300 = \$1245‘50, *Ans.*

4. \$149‘20 (amount of \$40 for 39 years) + \$40 = \$189‘20, which × 40 = \$7568; \$7568 ÷ 2 = \$3784, which + \$1500 = \$5284, *Ans.*

5. \$6342 ÷ 20 = \$317‘10, gain in 1 year. \$983‘01 (amount of \$317‘10 for 30 years) + \$317‘10 = \$1300‘11, which × 31 = \$40303‘41, and \$40303‘41 ÷ 2 = \$20151‘705, *Ans.*

¶ 221. EXERCISES.

1. The extremes are 30 and 0; then, 30 + 0 = 30, which × 20 = 600, and $\frac{600}{2}$ = 300, *Ans.*

2. \$75 + \$5 = \$80, which × 11 = \$880, and \$880 ÷ 2 = \$440, whole debt; \$75 — \$5 = \$70, which ÷ (11 — 1 =) 10 = \$7, common difference, *Ans.*

3. 1001 — 1 = 1000, which ÷ 2 = 500, number of additions, and 500 + 1 = 501, number of terms; then, 1001 + 1 = 1002, which × 501 = 502002, and $\frac{502002}{2}$ = 251001, *Ans.*

4. \$‘04 + \$3‘01 = \$3‘05, which × 100 = \$305, and \$305 ÷ 2 = \$152‘50, *Ans.*

5. \$1570 is the sum of the series, 20 years the number of terms, and \$‘06 is the common difference of a series of which \$1 is the 1st term. Hence the operation is the reverse of ¶ 219. \$1570 × 2 = \$3140, (twice the series,) which ÷ 20 (the number of terms) = \$157, the sum of the extremes of a series of which \$1 is the first term, 20 the number of terms.

and \$1‘06 the common difference; then, \$2‘14 (amount of \$1 for 19 years) + \$1 = \$3‘14, and \$157 ÷ \$3‘14 = \$50, *Ans.*

6. $50 - 1 = 49$, which $\times \frac{1}{2} = 24\frac{1}{2}$, sum of the additions, and $24\frac{1}{2} + 2 = 26\frac{1}{2}$, last term; then, $26\frac{1}{2} + 2 = 28\frac{1}{2}$, which $\times 50 = 1425$, and $\frac{1425}{2} = 712\frac{1}{2}$, *Ans.*

7. $30 - 0 = 30$, which $\div \frac{1}{3} = 90$, and $90 + 1 = 91$, number of terms; then, $(30 + 0 =)\ 30 \times 91 = 2730$, which $\div 2 = 1365$, *Ans.*

8. The number of terms is 59. \$117 (amount of \$30 for 58 years) + \$30 = \$147, which × 59 = \$8673, and \$8673 ÷ 2 = \$4336‘50, *Ans.*

GEOMETRICAL PROGRESSION.

¶ 223. EXAMPLES FOR PRACTICE.

2.

NOTE. The 4 kernels planted is the first term, and the 32 kernels harvested the second, both within the first year; it follows, therefore, that the number of terms in this example is 1 more than the number of years.

Indices: 1, 2, 3, 4, 5,
Powers: 8, 64, 512, 4096, 32768; } then, 1 + 2 + 3 + 4 + 5 = 15, an index less by 1 than the number of terms; multiplying the powers of these several indices, we have 32768 × 4096 × 512 × 64 × 8 = 35184372088832, which × 4 (the first term) = 140737488355328, number of kernels, ÷ 1000 (number of kernels in a pint) = 140737488355‘328 pints ÷ 64 (number of pints in a bushel) = 2199023255‘552 bush., *Ans.*

3. 1824 − 1620 = 204, which ÷ 12 = 17, number of terms less one; then, $2^{17} = 131072$, which × \$‘01 = \$1310‘72, *Ans.*

4. $3^{6} = 729$, which $\times 5 = 3645$, *Ans.*

5. $3^{7} = 2187$, and $10935 \div 2187 = 5$, *Ans.*

6. $2^{16} = 65536$, and $196608 \div 65536 = 3$, *Ans.*

7. 700000000 ÷ 7 = 100000000, which may be divided by the ratio, 10, the quotient thence arising by 10, and so on for 8 divisions; then, 8 (divisions by the ratio) + 1 (division by the first term) = 9, the number of terms, *Ans.*

Compound Interest by Progression.

¶ 224. EXAMPLES FOR PRACTICE.

2. 1‘05^{11} = 1‘71033+, and \$40 × 1‘71033 = \$68‘413+, *Ans.*

3. 1‘10^{4} = 1‘4641, and \$6 × 1‘4641 = \$8‘7846, *Ans.*

4. \$1191‘016 ÷ \$1000 = 1‘191016, which may be divided by 1‘06, and the quotient thence arising by 1‘06, and this last quotient by 1‘06; then, the three divisions = 3 years, *Ans.*

¶ 226. *The extremes and the ratio given, to find the sum of the series.*

EXAMPLES FOR PRACTICE.

2. 131072 × 8 = 1048576, which — 4 = 1048572, and 1048572 ÷ 7 = 149796, *Ans.*

3. 3 × 3 = 9, which — 0 = 9, and 9 ÷ 2 = 4½, *Ans.*

4. 1 × 4 = 4, which — 0 = 4, and 4 ÷ 3 = 1⅓, *Ans.*

5. $\frac{1}{10}$ × 10 = 1, which — 0 = 1, and 1 ÷ 9 = $\frac{1}{9}$, *Ans.*

6. $\frac{2}{100}$ × 100 = 2, which — 0 = 2, and 2 ÷ 99 = $\frac{2}{99}$, *Ans.*

¶ 227. *The first term, ratio, and number of terms given, to find the sum of the series.*

EXAMPLES FOR PRACTICE.

3. 10^{40} = 1 with forty ciphers annexed, which — 1 would = forty 9s; then, ÷ $\overline{10-1}$ = forty 1s, the number of kernels, which ÷ 1000 = number of pints, and this dividend ÷ 64 (number of pints in a bushel) = number of bushels, which × ‘50 = *Ans.*

Annuities at Compound Interest.

¶ 228. EXAMPLES FOR PRACTICE.

2. $\dfrac{1\text{‘}05^{20}-1}{1\text{‘}05-1}=\dfrac{2\text{‘}65329-1}{1\text{‘}05-1}=\dfrac{1\text{‘}65329}{\text{‘}05}=$ 33‘0658, which × \$50 (the annuity) = \$1653‘29, *Ans.*

3 $\dfrac{1\text{‘}10^{4}-1}{1\text{‘}10-1}=\dfrac{1\text{‘}4641-1}{1\text{‘}10-1}=\dfrac{\text{‘}4641}{10}=$ 4‘641, which × \$150 (the annuity) × \$696‘15, *Ans.*

4. $$\frac{1‘06^{24}-1}{1‘06-1}=\frac{4‘048930}{1‘06-1}-\frac{1=3‘048930}{‘06}=50‘8155,$$
which × $500 = $25407‘75, *Ans. to the last.*

5. $200 × ‘20 — $40; then, $\frac{1‘06^{40}-1}{1‘06-1}=\frac{10‘285718-1}{1‘06-1}$
$=\frac{9‘285718}{‘06}=154‘7619\frac{2}{3}$, which × $40 = $6190‘478⅔, *Ans.*

6. $$\frac{1‘06^{30}-1}{1‘06-1}=\frac{5‘743491-1}{1‘06-1}=\frac{4‘743491}{‘06}=79‘0581\tfrac{1}{3},$$
which × $100 = $7905‘818⅓, *Ans.*

Present Worth of Annuities at Compound Interest.

¶ 229. EXAMPLES FOR PRACTICE.

2. $\frac{1‘06^{4}-1}{1‘06-1}=\frac{1‘26247-1}{1‘06-1}=4‘3745$, which × $100 (the annual pension) = $437‘45; and $437‘45 ÷ $1‘26247 (amount of $1 for 4 years) = $346‘503+, *Ans.*

3. $\frac{1‘05^{20}-1}{1‘05-1}=\frac{2‘65329-1}{1‘05-1}=33‘0658$, which × $100 = $3306‘58, and this sum ÷ $2‘65329 (amount of $1 for 20 years) = $1246‘218+, *Ans.*

¶ 230. EXAMPLES FOR PRACTICE.

1. $15‘37245 (present worth of $1) × 150 (=$150 annuity) = $2305‘8675, *Ans.*

2. $16‘1929 × 40 = $647‘716, *Ans. to last.*

Annuities at Compound Interest in Reversion.

¶ 231. EXAMPLES FOR PRACTICE.

3. $3‘4651 (present worth of $1 annuity) × 100 = $346‘51, which ÷ $1‘1236 (amount of $1 for 2 years at 6 per cent., compound interest) = $308‘392+, *Ans.*

4. *The last.* Present worth, to commence immediately, $1246‘221, which ÷ 1‘97993 ($1‘05^{14}$) = $629‘426, *Ans.* Or, by the table, whole time, 34 years, = $16‘1929
Time in reversion, 14 years, = $9‘89864

Difference, $6‘29426, which × 100 (the annuity) = $629‘426, *Ans.* as before.

5. 1840 — 1817 = 23 years, whole time the pension con-

tinued; 1817 — 1783 = 34 years, whole time in reversion; $12‘30338 (present worth of $1 annuity for 23 years) × 96 = $1181‘12448, present worth to commence immediately, which ÷ 7‘251025 ($1‘06^{34}$) = $162‘89+, *Ans.*

¶ 232. Perpetual Annuities.

2. $800 ÷ ‘07 = $11428‘57+, *Ans.*

3. $100 ÷ ‘20 = $500, *Ans.*

5. $100 ÷ ‘05 = $2000, worth, if entered on now, which — $1537‘245 (present worth of 100 for 30 years) = $462‘755, *Ans.*

PERMUTATION.

¶ 233. 2. 1 × 2 × 3 × 4 × 5 × 6 × 7 × 8 × 9 = 362880, *Ans.*

3. 1 × 2 × 3 × 4 × 5 × 6 × 7 × 8 × 9 × 10 × 11 × 12 × 13 × 14 × 15 × 16 × 17 × 18 × 19 × 20 × 21 × 22 × 23 × 24 × 25 = $15511210043330985984000000, *Ans.*

4. 1 × 2 × 3 × 4 × 5 × 6 × 7 × 8 = 40320, *Ans.*

MISCELLANEOUS EXAMPLES.

¶ 234. 1. (7 + 4 =) 11 — (2 + 3 =) 5 = 6, 6 + 40 = 46, and 46 × 5 = 230, *Ans.*

2. 990 — 90 = 900, (their sum if the numbers were each equal to the smaller,) 900 ÷ 2 = 450, the smaller number, and 450 + 90 = 540, the larger number, *Ans.*

3. The least number of pounds is the least common multiple of all the given numbers, ¶ 73, Note 2.

```
2 ) 48,  76,  87,  90,
   ___________________
3 ) 24,  38,  87,  45,
   ___________________
  2 ) 8,  38,  29,  15,     2 × 3 × 2 × 4 × 19 × 29 ×
     _________________
      4,  19,  29,  15,     15 = 396720, Ans.
```

4. 2s. 3d. = 27d., which × ‘02$\frac{1}{60}$ = $‘54$\frac{9}{20}$; $‘54$\frac{9}{20}$ × 15 = $8‘16$\frac{3}{4}$, cost of the cloth, which ÷ $1‘50 = 5$\frac{89}{200}$ bushels, *Ans.*

5. If $‘30 gain $‘05, $‘01 will gain $\frac{1}{30}$ of $‘05 = $\frac{1}{6}$ of 1 cent, and ($3‘75 =) 375 cents will gain 375 times $\frac{1}{6}$ of 1 cent = $‘62$\frac{1}{2}$, which + $3‘75 = $4‘37$\frac{1}{2}$, *Ans.*; or, $‘$\overset{6}{\cancel{30}}$: $‘$\overset{7}{\cancel{35}}$: : $3‘75 : $4‘37$\frac{1}{2}$, *Ans.* as before.

6. I paid 100 per cent. — $33\frac{1}{3}$ per cent. $= 66\frac{2}{3}$ per cent. of the cost; $\$4‘50 \times ‘66\frac{2}{3} = \$3‘00$, *Ans.*

7. $\$42 \times ‘15 = \$6‘30$; then, $\$42 + \$6‘30 = \$48‘30$, price of the whole, and $\$48‘30 \div 120 = \$‘40\frac{1}{4}$, *Ans.*

8. $\$150 \div \$1‘15 = \$130‘434+$, *Ans.*

9. $\$1000 \div \$1‘25 = \$800$, *Ans.*

10. $\$4‘25 - \$3‘50 = \$‘75$, gain on 1 yard; $\frac{75}{350} = ‘21\frac{3}{7} = 21\frac{3}{7}$ per cent., *Ans.*

11. $20 \times 60 = 1200$ men will build it in 1 day, and $1200 \div 50 = 24$ men will build it in 50 days, *Ans.*

12. $12 \times \frac{5}{8} = \frac{60}{8}$, contents of the plaid, which $\div$ ($1\frac{1}{2} =$) $\frac{3}{2}$ (contents of 1 yd. of Silesia) $= 5$ yards, *Ans.*

13. $\frac{7}{5} - \frac{2}{6} = \frac{32}{30}$ of a gallon in 1 minute; then, $400 \div \frac{32}{30} = 375$ minutes $= 6$ hours 15 minutes, *Ans.*

14. $\frac{1}{10} - \frac{1}{15} = \frac{1}{30}$ part filled in 1 hour; then, $1 \div \frac{1}{30} = 30$ hours, *Ans.*

15. $500 for 4 mo. = $2000 for 1 mo., and $2000 for 1 mo. = $300 for $\frac{2000}{300} = 6\frac{2}{3}$ mo., *Ans.*

16. $800 \times 2 = 1600$ men can be served 1 mo., and $\frac{1600}{5} = 320$ men can be served 5 mo.; then, $800 - 320 = 480$ men, *Ans.*

17. ($45 - 16 =$) $29 \times \$3‘50 = \$101‘50$, cost of the better kind; and ($16 \times \frac{3}{4} =$) $12 \times \$3‘50 = \$42‘00$, cost of the poorer kind; then, $\$101‘50 + \$42‘00 = \$143‘50$, *Ans.*

18. $57 \div 4\ (40 - 36) = 14\frac{1}{4}$ minutes; and $40 \times 14\frac{1}{4} = 570$ rods, *Ans.*

19. $11 : 12 :: 1 : A. = 12 \div 11 = 1\frac{1}{11}$ hours $= 1$ hour 5 minutes $27\frac{3}{11}$ seconds, *Ans.*

20. B travels twice, and C three times, as fast as A; therefore, when A has travelled round once, B will have been round twice, and C three times, and there they will all be together for the first time; therefore, $20 \div 2 = 10$, number of hours A will be in passing round once. *Ans.*, 10 hours.

21. One moves 6, and the other 10 miles per hour, and both together 16; then, one will go $\frac{6}{16}$, and the other, $\frac{10}{16}$ of the whole distance; therefore, $300 \times \frac{6}{16} = 112\frac{1}{2}$, and $300 \times \frac{10}{16} = 187\frac{1}{2}$; or, $16 : 6 :: 300 : 112\frac{1}{2}$ miles, and $16 : 10 :: 300 : 187\frac{1}{2}$ miles, *Ans.*, as before.

22. $\frac{1}{3} + \frac{1}{4} = \frac{7}{12}$ of the army; therefore, 1000 is $\frac{5}{12}$ of the whole army; $1000 \div 5 = 200 = \frac{1}{12}$ of the army, which $\times 12 = 2400$, *Ans.*

23. $1 - \frac{15}{24}\ (\overline{\frac{1}{4} + \frac{1}{6} + \frac{1}{8} + \frac{1}{12}}) = \frac{9}{24}$; then 450 is $\frac{9}{24}$ of

the whole; therefore, $450 \div 9 = 50$, which $\times 24 = 1200$, *Ans.*

24. $1 - \frac{14}{15}\ (\overline{\frac{1}{3} + \frac{3}{5}}) = \frac{1}{15}$; 6 is $\frac{1}{15}$; then, $6 \times 15 = 90$ feet, *Ans.*

25. $1 - \frac{71}{80}\ (\overline{\frac{1}{16} + \frac{3}{8} + \frac{3}{10} + \frac{3}{20}}) = \frac{9}{80}$; 9 is $\frac{9}{80}$ of the whole; then, $(9 \div 9 =)\ 1 \times 80 = 80$, whole number, *Ans.*

26. $100 - 2\frac{1}{2} = 97\frac{1}{2}$, which is $\frac{3}{2}$ of the whole flock; and $97\frac{1}{2} \div 3 = 32\frac{1}{2}$, which $\times 2 = 65$ geese, *Ans.*

27. $1 - \frac{11}{12}\ (\overline{\frac{1}{2} + \frac{1}{4} + \frac{1}{6}}) = \frac{1}{12}$; then, 100 is $\frac{1}{12}$, and $100 \times 12 = 1200$, *Ans.*

28. $\frac{7}{8} - \frac{4}{5} = \frac{3}{40}$; then, 6 is $\frac{3}{40}$ of the number; $6 \div 3 = 2 = \frac{1}{40}$ of the number, which $\times 40 = 80$, *Ans.*

29. $84 = \frac{7}{4}$ of the number; then, $84 \div 7 = 12$, which $\times 4 = 48$, *Ans.*

30. $93 = \overline{1 + 1\frac{1}{2} + 5\frac{1}{4}} = 7\frac{3}{4}$ times A's age; then, $93 \div 7\frac{3}{4} = 12$, A's; $12 \times 1\frac{1}{2} = 18$, B's; and $12 \times 5\frac{1}{4} = 63$, C's, *Ans.*

31. $435 = \overline{1 + 1 + \frac{3}{4} + \frac{1}{2} + \frac{1}{4} + \frac{1}{8}} = \frac{29}{8}$ of his sheep· then, $435 \div 29 = 15$, which $\times 8 = 120$, *Ans.*

32. $22 = (3 - 2\frac{4}{15} =)\ \frac{11}{15}$ of the number sought; then, $22 \div \frac{11}{15} = 30$, *Ans.*

33. ($\frac{1}{2}$ of $\frac{6}{5} = \frac{3}{5}$, that is,) $\frac{3}{5}$ of the stock, is equal to $\frac{5}{5}$, that is, the whole stock, less \$200; consequently \$200 is $\frac{2}{5}$ of the stock; $\$200 \div 2 = \$100$, which $\times 5 = \$500$, *Ans.*

34. Had he worked every day, his wages would have been $\$‘75 \times 50 = \$37‘50$, that is, \$10 more than he received; but every day he was idle lessened his wages $\$‘75 + \$‘25 = \$1$; consequently he was idle 10 days, and 50 days — 10 days = 40 days, *Ans.*

35. $\$40 \div \$8 = \$5$, what B spends more than his income, in a year; then, $\$30 - 5 = \$25$, which must be $\frac{1}{8}$ of their income; $\$25 \times 8 = \$200$, whole income of each; and $\$200 \times \frac{7}{8} = \$175$, what A spends; and $\$175 + \$30 = \$205$, what B spends.

36. A has $\frac{1}{2} - \$20$, and C $\frac{1}{2} - \$30$; then, A and C have the whole — \$50, which must be B's share, or $\frac{1}{4}$; then, $\$50 \times 4 = \$200$, whole estate; and $200 \div 2 = \$100$, which $- 20 = \$80$, A's share; $\$200 \div 4 = \$50$, B's share; and $\$200 \div 2 = \$100$, which $- \$30 = \$70$, C' share.

37. The length of the body is $\frac{1}{2}$ the length of the whole fish; the length of the tail is $\frac{1}{4} + 4$ feet; and the head is 4 feet; then, $\frac{1}{2} + \frac{1}{4} + 4 + 4 = (\frac{3}{4} + 8 =)$ whole length of

the fish, and consequently $8 = \frac{1}{4}$, and $8 \times 4 = 32$ feet, *Ans.*

38. A can do $\frac{1}{4}$, and B $\frac{1}{3}$, per day, and both, working together, $\frac{1}{4} + \frac{1}{3} = \frac{7}{12}$; then, $1 \div \frac{7}{12} = 1\frac{5}{7}$ days, *Ans.*

39. A and B can do $\frac{1}{4}$, B and C $\frac{1}{6}$, and A and C $\frac{1}{5}$, per day; then, $\frac{1}{4} + \frac{1}{6} + \frac{1}{5} = \frac{37}{60}$, which $\div 2$ (because each man, by the conditions, is taken twice) $= \frac{37}{120}$ what all would do in 1 day; then, $1 \div \frac{37}{120} = 3\frac{9}{37}$ days, *Ans.*

40. A and B together can do $\frac{1}{5}$, and A can do $\frac{1}{7}$ alone; then, $\frac{1}{7} - \frac{1}{5} = \frac{2}{35}$ what B can do in a day; then, $1 \div \frac{2}{35} = 17\frac{1}{2}$ days, *Ans.*

$$\left.\begin{array}{l}\text{41. Am't of \$1‘00 for (21—18) 3 yrs.} = \$1‘18\\ \text{Am't of \$1‘00 for (21—14) 7 yrs.} = \$1‘42\end{array}\right\} = \$2‘60.$$

Then, (as they will receive inversely as the time,)
$2‘60 : $1‘42 : : $1000 : $546‘153+, the elder br.'s share.
$2‘60 : $1‘18 : : $1000 : $453‘846+, the younger br.'s share.

42. $60 is the first term, $‘06 the common difference, and 5 the number of terms; then, 4 × $‘06 = $‘24, which × $60 = $14‘40, and $14‘40 + $60 = $74‘40, the last term; then, $74‘40 + $60 = $134‘40, which × 5 = $672, and $672 ÷ 2 = $336, *Ans.*

43. 30 × 3 = 90, which × $‘50 = $45‘00, price of 100 yards calico; and $45 ÷ 100 = $‘45, price of 1 yard of calico; $‘45 × 40 = $18, which ÷ (12 × 3 =) 36 = $‘50, price of 1 pair of gloves; then, $4 ÷ $‘50 = 8 = 8 pairs, *Ans.*

44. B has $3, and C $7, more than A; $3 + $7 = $10, which, taken from $100 = $90, and $90 ÷ 3 = $30, A's share; $30 + $3 = $33, B's share; and $30 + $7 = $37, C's share, *Ans.*

45. 30 gal. = 240 pts., which ÷ 3 pts. (2 pts. + 1 pt.) = 80, *Ans.*

46. 12 cwt. 3 qrs. 12 lbs. = 1440 lbs., which ÷ 24 lbs. (12 lbs. + 7 lbs. + 5 lbs.) = 60, *Ans.*

47. 15 oz. 6 pwt. = 7344 grs.; 12 pwt. = 288 grs., which + 18 grs. = 306 grs.; then, 7344 grs. ÷ 306 grs. = 24, *Ans.*

48. $3 + 5 + 7 = 15$ cts.; then, the first will have $\frac{3}{15}$ of $60 = 12$; the second $\frac{5}{15}$ of $60 = 20$; and the third, $\frac{7}{15}$ of $60 = 28$, *Ans.*

49. Since there were 3 women to every boy, and 6 men to every boy, as often as he gave $‘06 to a boy, he gave $‘08 × 3 = $‘24 to a woman, and $‘16 × 6 = $‘96 to a man; then, $‘06 + $‘24 + $‘96 = $1‘26; $18‘90 ÷ $1‘26 = 15 boys; 15 × 3 = 45 women; and 15 × 6 = 90 men, *Ans.*

50. $\$82‘50 = \overline{1 + 8 + 24} = 33$ times the price of the

sheep, then, $82‘50 × $\frac{1}{33}$ = $2‘50, sheep; $82‘50 × $\frac{8}{33}$ = $20, cow; and $82‘50 × $\frac{24}{33}$ = $60, oxen, *Ans.*

51. 1 — $\frac{31}{40}$ ($\frac{2}{5}$ + $\frac{3}{8}$) = $\frac{9}{40}$, what C furnished; then, $1250 × $\frac{2}{5}$ = $500, A's; $1250 × $\frac{3}{8}$ = $468‘75, B's; and $1250 × $\frac{9}{40}$ = $281‘25, C's share, *Ans.*

52. First, to find the gain of A and B; C's gain being $120, $332‘50 — 120 = $212‘50, the gain of A and B together; then, $850 : $500 : : $212‘50 : $125, A's; and $850 : $350 : : $212‘50 : $87‘50, B's. To find the price of C's cloth per yard; if C's share of the gain is $\frac{48}{133}$ of the whole gain, his share of the stock must have been $\frac{48}{133}$ of the whole; and 1 — $\frac{48}{133}$ = $\frac{85}{133}$ must be equal to A and B's stock together, viz. $850; then, $850 ÷ 85 = $10, $\frac{1}{133}$ of the stock, which × 48 (C's share) = $480, C's stock, which ÷ 120 = $4 per yard, *Ans.*

53. As often as A paid $5, B paid $7, and C $10‘50; $5 + $7 + $10‘50 = $22‘50; then, $22‘50 : $5 : : $580‘80 : 129‘066$\frac{2}{3}$, A's; $22‘50 : $7 : : $580‘80 : $180‘693$\frac{1}{3}$, B's; and $22‘50 : $10‘50 : : $580‘80 : $271‘04, C's, *Ans.*

54. As often as A had $9, B had $5, and C $\frac{3}{7}$ of $5 = 2\frac{1}{7}$; $9 + $5 + 2\frac{1}{7}$ = 16\frac{1}{7}$; then, 2\frac{1}{7}$: 16\frac{1}{7}$: : $7442‘105 : $56063‘857$\frac{2}{3}$, *Ans.*

55. 9 months : 12 months : : $1200 : $1600, *Ans.*

56. $\frac{3}{4}$ + $\frac{9}{10}$ + $\frac{13}{20}$ = $\frac{46}{20}$, which ÷ 2 (as each man's horses are taken twice in the question) = $\frac{23}{20}$; then, $\frac{23}{20}$ — $\frac{3}{4}$ (A's and B's) = $\frac{8}{20}$, C's; $\frac{23}{20}$ — $\frac{9}{10}$ (A's and C's) = $\frac{5}{20}$, B's; and $\frac{23}{20}$ — $\frac{13}{20}$ (B's and C's) = $\frac{10}{20}$, A's; then, A will have $\frac{10}{23}$ of $26‘45 = $11‘50; B will have $\frac{5}{23}$ = $5‘75, and C $\frac{8}{23}$ = $9‘20.

57. $2178 ÷ $\frac{3}{8}$ = $5808, the money he had *after* he bought his commission, to which + $7260 = $13068, what he had *before* he bought his commission; this must be $\frac{5}{7}$ ($\frac{7}{7}$ — $\frac{2}{7}$) of his fortune; then, $13068 ÷ $\frac{5}{7}$ = $18295‘20, *Ans.*

58. 1560£. ÷ $\frac{7}{12}$ = $\frac{18720}{7}$£., the elder brother's fortune, which × $\frac{43}{8}$ (5$\frac{3}{8}$) = $\frac{804960}{56}$£., which is $\frac{3}{8}$ of twice as much as the father was worth; then, $\frac{804960}{56}$ ÷ $\frac{3}{8}$ = $\frac{6439680}{168}$£., which ÷ 2 = $\frac{3219840}{168}$£. = 19165£. 14s. 3$\frac{3}{7}$d., *Ans.*

59. $\frac{3}{4}$ of $\frac{5}{6}$ = $\frac{5}{8}$; then, 537£. is $\frac{8}{8}$ — $\frac{5}{8}$ = $\frac{3}{8}$, and 537£. ÷ $\frac{3}{8}$ = 1432£., the sum he had after he had spent $\frac{5}{16}$ of his fortune, and consequently this must be $\frac{11}{16}$ of what he had at first; then, 1432£. ÷ $\frac{11}{16}$ = 2082£. 18s. 2$\frac{2}{11}$d., *Ans.*

60. 231 + 44 = 275 is the whole number of men added to two sides; but since the man at the corner is counted twice, we + 1 to 275 = 276, which ÷ 2 = 138, the number of

men on a side after the addition; then, $138^2 = 19044$, which $- 44 = 19000$, *Ans.*

61. $40 \times 40 = 1600$, the last number, which $\div 4 = 400$, the second number, and this $\div 4 = 100$, first number, *Ans.*

62. $100^2 - 80^2 = 10000 - 6400 = 3600$; then, $\sqrt{3600} = 60$, hight of the steeple, which $\times 3 = 180$, hight of the spire; to find the length of the line, $180^2 + 80^2 = 32400 + 6400 = 38800$, and $\sqrt{38800} = 197$ feet, nearly, *Ans.*

63. $7\frac{1}{2}^2 + 10^2 = \frac{15}{2}^2 + \frac{20}{2}^2 = \frac{225}{4} + \frac{400}{4} = \frac{625}{4}$; then, $\sqrt{\frac{625}{4}} = \frac{25}{2} = 12\frac{1}{2}$ miles apart in 1 hour, which $\times 24 = 300$ in one day, which $\times 3 = 900$, *Ans.*

64. $70{\cdot}71^2 = 5000$ P., (nearly,) twice the area, which $\div 2 = 2500$ P., area; 2500 P. $= 15\frac{3}{8}$ A., *Ans.*

65. $5280^3 = 147197952000$ cu. ft. in 1 cu. mi.; 1320 (ft. wide) $\times$ 10 (ft. deep) $\times$ 21120 (ft. in 4 mi.) $= 278784000$ cu. ft. discharged in 1 hour; then, $147197952000 \div 278784000 = 528$ hours $= 22$ days, *Ans.*

66. $380 \times 120 = 45600$; then, $45600 : 62700000 :: 1 : A. = 62700000 \div 45600 = 1375$ times, *Ans.*

67. 24 h. $\times 365 = 8760$ h., which $\div$ 528 h. (22 d.) $= 16\frac{13}{22}$, (cu. mi.,) what the Po will discharge in 365 days, which $\times 1375 = 22812\frac{1}{2}$ cu. mi., *Ans.*

68. $5 : 10\frac{1}{2} :: 62700000 : A. = 62700000 \times 10\frac{1}{2} = 658350000$, which $\div 5 = 131670000$, number of square miles of water, which $\times 1\frac{1}{2} = 197505000$, number of cu. miles in the ocean, which $\div 22812\frac{1}{2}$ (number of cu. miles of water discharged by all the rivers into the sea in 1 year) $= 8657$ years 275 days, *Ans.*

69. 1000 oz. $\times 13\frac{1}{2} \times 2\frac{1}{2}$ (30 in. $= 2\frac{1}{2}$ ft.) $= 33750$ oz., which $\div 16 = 2109{\cdot}375$ lbs. on a square foot; then, $2109{\cdot}375$ lbs. $\times 27878400$ (5280^2) $= 58806000000$ lbs. on a square mile; and 131670000 (square miles of water) $+$ 62700000 (square miles of land) $= 194370000$ square miles on the surface of the globe, which $\times$ 58806000000 (lbs. on 1 square mile) $= 11430122220000000000$ lbs., weight of the whole atmosphere, *Ans.*

70. Detroit being west of Boston, his watch was too fast; $82° 58' - 71° 4' = 11° 54'$, difference in longitude, which $\times 4 = 47$ m. 36 s. too fast, *Ans.*

71. $90° 15' - 70° 20' = 19° 55'$, difference in longitude, which $\times 4 = 1$ h. 19 m. 40 s., difference in time, and this $-$ 3 m. $= 1$ h. 16 m. 40 s., to be taken from the time at Portland; 9 h. $-$ 1 h. 16 m. 40 s. $= 7$ h. 43 m. 20 s., *Ans.*

72. 120 miles $= 633600$ feet, which $\div$ 1142 ft. $= 554+$ seconds $= 9$ minutes $14+$ seconds, *Ans.*

73. 1142 ft. × 8 = 9136 ft. = 1 mi. 3856 ft., *Ans.*

74. 2 s. × 3 = 6 s., and 1142 ft. × 6 = 6852 ft. = 1 mi. 1572 ft., *Ans.*

75. By the conditions, the width is 3 times, and the length 6 times the depth; 144 cu. yds. ÷ 3 = 48 cu. yds. in a portion of the cellar $\frac{1}{3}$ the whole width, and 48 cu. yds. ÷ 6 = 8 cu. yds. in a portion of the same length and width as the whole depth of the cellar; then, 8 cu. yds. = 216 cu. ft., $\sqrt[3]{216} = 6$ ft., depth of the cellar, which × 6 = 36 ft., length, *Ans.*

76. Less money more time; $\$\overset{3}{\cancel{45}}|0 : \$\overset{5}{\cancel{75}}|0$: : 8 months : 1 year 1 month 10 days, *Ans.*

77. $3 + 5 = 8$; then, 8 : 5 : : $266\frac{2}{3}$: $166\frac{2}{3}$, the greater number, and 8 : 3 : : $266\frac{2}{3}$: 100, the less, *Ans.*

78. $10^2 = 100$ square rods, which — 19 square rods = 81 square rods of the park not occupied by the walk; $\sqrt{81} = 9$ rods, 1 side of the square enclosed by the walk; then, 10 rods — 9 rods = 1 rod = $16\frac{1}{2}$ ft., which ÷ 2 (as the walk is twice measured in measuring 1 side of the park) = 8 ft. 3 in., *Ans.*

79. 7 is the sum, and 1 the difference, of B and C's proportions of the whole stock; $7 - 1 = 6$, which $\div 2 = 3$ = B's proportion of the stock, (¶ 234, Ex. 2,) $7 - 3 = 4$ = C's proportion, and 5 (the sum of A and B's proportions) — 3 (B's proportion) = 2 = A's proportion; $2 + 3 + 4 = 9$ = sum of their proportions; then, A had $\frac{2}{9}$ of \$610‘65 = \$135‘70, B had $\frac{3}{9}$ = \$203‘55, and C had $\frac{4}{9}$ = \$271‘40, *Ans.*

MEASUREMENT OF SURFACES.

¶ 235. 1. 80 rds. × 20 rds. = 1600 P., *Ans.*

3. $\frac{1‘8 + 1‘3}{2} = 1‘55$ ft., which × 16 ft. = 24‘8 sq. ft., *Ans.*

4. 30 rds. × 5 rds. ($\frac{10}{2}$ rds.) = 150 P., *Ans.*

5. 600 P. ÷ 75 rds. = 8 rds., which × 2 = 16 rds., *Ans.*

6. 40 rds. ÷ 2 = 20 rds., ($\frac{1}{2}$ the altitude,) and 400 P. ÷ 20 rds. = 20 rds., *Ans.*

7. $\frac{1\frac{1}{2} + 0}{2} = \frac{3}{4}$ ft., which × 18 ft. = $13\frac{1}{2}$ sq. ft., *Ans.*

8. 147 ft. × $3\frac{1}{7}$ = 462 ft., circumference; 147 ft. × 147 ft. × ‘7854 = 16971‘7 + sq. ft., *Ans.*

9. 22 ft. ÷ $3\frac{1}{7}$ = 7 ft., *Ans.*

10. 7911 mi. × 3‘14159 = 24853 mi., nearly, *Ans.*

11. $3\frac{1}{2}$ in. × $3\frac{1}{7}$ = 11 in., the circumference; 11 in. × $\frac{7}{8}$ in. ($\frac{1}{4}$ of $3\frac{1}{2}$ in.) = $\frac{77}{8}$ sq. in., which × 4 = $38\frac{1}{2}$ sq. in., *Ans.*

12. To multiply the circumference by $\frac{1}{4}$ of the diameter, and the resulting product by 4, is, in effect, multiplying the diameter and circumference together; therefore, 24853 mi. × 7911 mi. = 196612083 sq. mi., *Ans.*

Measurement of Solids.

¶ 236. 2. 196612083 sq. mi. × 1318$\frac{1}{2}$ mi. ($\frac{1}{6}$ of 7911 mi.) = 259233031435$\frac{1}{2}$ cu. mi., *Ans.*

3. 2 ft. × 2 ft. × ‘7854 = 3‘1416 sq. ft., contents of one end, which × 20 ft. = 62‘832 cu. ft., *Ans.*

4. 18‘5 in. × 18‘5 in. × ‘7854 = 268‘8 + sq. in., contents of one end, which × 8 in. = 2150‘4 + cu. in., *Ans.*

5. 4 ft. × 4 ft. × 9 ft. = 144 cu. ft., which ÷ 3 = 48 cu. ft., *Ans.*

6. 7 ft. × 3$\frac{1}{7}$ = 22 ft., circumference; then, 22 ft. × $\frac{7}{4}$ ft. = 38$\frac{1}{2}$ sq. ft., the area of the base, which × 9 ft. (27 ÷ 3) = 346$\frac{1}{2}$ cu. ft., *Ans.*

7. 81 (9^2) + 16 (4^2) + 36 ($\sqrt{81 \times 16}$) = 133 sq. in., which × 72 in. (18 ft. ÷ 3 = 6 ft. = 72 in.) = 9576 cu. in. = 5 cu. ft. 936 cu. in., *Ans.*

8. 2‘56 ($1‘6^2$) + ‘81 ($‘9^2$) + 1‘44 ($\sqrt{1‘6 \times ‘9}$) = 4‘81, which × ‘7854 = 3‘777774 sq. ft., and this × 12 ft. (36 ft. ÷ 3) = 45‘333 + cu. ft., *Ans.*

Gauging, or Measuring Casks.

¶ 237. 2. 36 in. — 27 in. = 9 in.; and 27 in. + 6 in. ($\frac{2}{3}$ of 9 in.) = 33 in., mean diameter; then, 33^2 × ‘7854 × 45 = 38488‘527 cu. in., which ÷ 231 = 166‘617 gals., *Ans.*

¶ 238. 3. 1 lb. : 5 lbs. : : 4 ft. : 20 ft., *Ans.*

4. $\frac{1}{2}$ ft. : 40 ft. : : 175 lbs. : 14000 lbs., *Ans.*

5. 2 ft. 6 in. = 30 in., and 3 ft. 4 in. = 40 in.; then, as they would carry parts inversely as their distances from the bale, 70 in. : 30 in. : : 200 lbs. : 85$\frac{5}{7}$ lbs.; and 70 in. : 40 in. : : 200 lbs. : 114$\frac{2}{7}$ lbs., *Ans.*

7. 10 : 1 : : 60 in. : 6 in., *Ans.*

9. 10 ft. × 2 = 20 ft. = 240 in., diameter of the circle described by the power, which × 3$\frac{1}{7}$ = 754$\frac{2}{7}$ ft., circumference; then, 754$\frac{2}{7}$ ÷ $\frac{1}{4}$ = 3017$\frac{1}{7}$ lbs., balanced by 1 lb power, and 3017$\frac{1}{7}$ lbs. × 120 = 362057$\frac{1}{7}$ lbs., *Ans.*

10. 10 ft. = 120 in.; then, 1 in. : 120 in. : : 1 : 120, *Ans.*

11. 231 cu. in. (1 wine gal.) ÷ 4 = 57$\frac{3}{4}$ cu. in. in 1 qt.; then, 231 cu. in. — 57$\frac{3}{4}$ cu. in. = 173$\frac{1}{4}$ cu. in., *Ans.*

12. 14 qts. — 2$\frac{1}{2}$ qts. = 11$\frac{1}{2}$ qts., which ÷ 4 = 2$\frac{7}{8}$ gal., then, 231 cu. in. × 2$\frac{7}{8}$ = 664$\frac{1}{8}$ cu. in., *Ans.*

ADDENDA.

MISCELLANEOUS EXAMPLES.

6. $$\left[36^2 - \overline{5^2 \times 2} \div \overline{7 + 8 + 5}\right] \times \begin{Bmatrix}7\\8\\5\end{Bmatrix} = \left.\begin{matrix}486\text{‘}1+ \text{A.}\\498\text{‘}4+ \text{B.}\\311\text{‘}5+ \text{C.}\end{matrix}\right\}\text{Now,}$$

$\sqrt{}(311\text{‘}5 + \overline{5^2 \times 2}) = \sqrt{}861\text{‘}5 = 19\text{‘}018153$, Diam. when C begins.
$\sqrt{}(498\text{‘}4 + 361\text{‘}5) = \sqrt{}859\text{‘}9 = 29\text{‘}324051$, Diam. when B begins.

$$\left.\begin{array}{l}\text{Therefore, } 36 - 29\text{‘}824051 = 6\text{‘}675949 \text{ in. A grinds.}\\ 29\text{‘}324051 - 19\text{‘}013153 = 10\text{‘}310898 \text{ in. B grinds.}\\ 19\text{‘}013153 - \sqrt{}(5^2 \times 2) = 11\text{‘}942086 \text{ in. C grinds.}\end{array}\right\}\textit{Ans.}$$

NOTE. The diameter of the circle circumscribing the waste hole = $(5^2 \times 2) = 50 =$ 7‘0171067+ in.

11. In this question, 60 represents the sum of the hypothenuse and perpendicular, and 20 the base of a right-angled triangle. Now, if we can find the difference between the hypothenuse and perpendicular, we shall have the *sum* and *difference* of two numbers to find the numbers, that is, the hypothenuse and perpendicular. The difference may be found by the application of the principle contained in the note to Ex. 11, at the end of the Misc. Examples. Hence, $20^2 = 400 =$ the difference of the squares of the hyp. and perp., or, which is the same thing = the product of the sum (60), and the difference of two numbers, which represent the hypothenuse and perpendicular. Hence, we have the product (400) of two factors = (60 × diff.), and one of the factors, to find the other factor, that is, the *difference*. $400 \div 60 = 6\frac{2}{3}$ difference. Now $\frac{60}{2} + \frac{6\frac{2}{3}}{2} = 33\frac{1}{3} =$ hyp., and $\frac{60}{2} - \frac{6\frac{2}{3}}{2} = 26\frac{2}{3}$ perp. *Ans.*

12. Find the value or amount of the yearly sum of 1‘00 at simple interest, for 3 successive years, thus: \$1‘12 + \$1‘06 + \$1‘00 = \$3‘18.

Now, \$3‘18, value or amount of the yearly sum, \$1‘00 : \$1180‘ value or amount of the yearly sum required, : : \$1‘00, yearly sum : $\$871\frac{11}{159}$. *Ans.*

13. Find the value or amount of the yearly sum of \$1‘00 at compound interest, for 3 successive years, thus: \$1‘1236 + \$1‘06 + \$1‘00 = \$8‘1836.

Now, \$3‘1836, value or amount of the yearly sum of 1‘00 : \$1191‘016, value or amount of the yearly sum required : : \$1‘00, yearly sum : $\$874\frac{874}{7959}$. *Ans.*

14. 1. Reduce the ring to an equal cylinder, that is, find the length of the axis of the ring, which will be the length of a cylinder of the same solidity. $\frac{\text{‘}9 + \text{‘}7}{2} = \text{‘}8$ diameter of the axis of the ring, — and ‘8 × 8‘14159 = 2‘513272 = length of the axis, or of the equal cylinder. Now, $\text{‘}1^2 \times 7854 \times 2\text{‘}518272 = \text{‘}019739238288$ cubic inches in the ring.

2. Reduce the outer half of the ring to an equal semi-cylinder. $\frac{\text{‘}9 + \text{‘}8}{2}$ = ‘85 diameter of the centre of the outer half of the ring. And ‘85 × 8‘14159 = 2‘6703515 length of the outer half, reduced to a semi-cylinder,

Now, $\frac{1^2 \times ‘7854 \times 2‘6703515}{2}$ = ‘0104864703405 cubic inches in the outer, or golden part of the ring. And ‘019789238288 — ‘0104864703405 = ‘0092527679475 cubic inches in the inner, or silver half of the ring. Now, 1728 c. in. : ‘0104864703405 c. in. : : [18888 oz. av. × $\frac{175}{192}$ = $\frac{787 \times 175}{8}$ = 17215‘625, oz. troy] : ‘104440899049018 ounces troy in the golden half of the ring. Now, £3 — 17 — 10½ = 934‘5 pence. And, ‘104440899049018 × 984‘5 = 97‘5995529113078210 pence = £0 — 8 — 1½. Now, 1728 : ‘0092527679475 : : [10535 × $\frac{175}{192}$ = 9602‘213+] : ‘0514161+ ounces troy in the silver part of the ring. Now, ‘0514161 × 66 d. = 8‘3984626 pence = 8¼ d. Now,

Value of the gold in the ring, ...	£0 — 8 — 1½
" " " silver in the ring, ...	0 — 0 — 8¼
Cost of making, ...	0 — 5 — 0
	£0 — 13 — 4¾ =

$\frac{643}{960}$ × $\frac{484}{100}$ = $8‘241 + Custom House value. *Ans.*

23. 14 oxen would have eaten the grass in 9 weeks, or 7 oxen in 18 weeks, if it had not grown after the first 6 weeks. For, *Inversely*, 9 w. : 6 w. : : 21 oxen : 14 oxen. And 18 w. : 6 w. : : 21 oxen : 7 oxen. But, as it required 18 oxen to eat it up in 9 weeks, 18 — 14 = 4 oxen must have been fed 9 weeks by its growth during the last 3 weeks; and it is evident, the same quantity would have fed half that number for double the time, that is, 2 oxen for eighteen weeks. At the same rate 8 oxen may be fed by the growth or increase of the grass during the 12 weeks, which remain after the first 6 weeks. For, *Directly*, 3 w. : 12 w. : : 2 oxen : 8 oxen. Thus the grass, which grows during the last 12 weeks, will feed 8 oxen, and that which was on the field at the beginning of the 18 weeks, together with its growth during the first 6 weeks, will feed 7 oxen. Hence, 8 oxen + 7 oxen = 15 oxen. *Ans.*

25. 1. By the *first condition* of the question, 9 oxen eat up 3 acres of grass and its growth in 5 weeks; the 10 acres being $\frac{10}{3}$ of 3 acres, it would require $\frac{10}{3}$ as many oxen to eat up 10 acres of grass, and its growth in the same time; and 9 oxen multiplied by $\frac{10}{3}$ are 30 oxen. To eat up the same in 10 weeks, would require $\frac{5}{10}$ only = ½ as many oxen; and 30 oxen multiplied by ½ are 15 oxen.

2. By the *second condition*, 20 oxen eat up 10 acres of grass and its growth in 10 weeks; and 20 oxen — 15 oxen are 5 oxen. Then it follows, that 5 oxen in 10 weeks would eat up the growth of 10 acres of grass during the five remaining weeks. To eat up the growth of 10 acres during 10 weeks, would require 2 times as many oxen; and five oxen multiplied by 2 are 10 oxen. Then, 20 oxen less 10 oxen are 10 oxen. Hence, it is evident that ten oxen in 10 weeks would eat up the grass at first on the 10 acres; and it is also evident that ten oxen in 10 weeks would eat up the growth of the ten acres of grass during the 10 weeks.

3. The 30 acres in the *third condition*, being $\frac{30}{10}$ or 3 times 10 acres, it would require 3 times 10 oxen to eat up the grass at first on the 30 acres, in 10 weeks; and 10 oxen multiplied by three are 30 oxen. To eat up the same in 25 weeks, would require only $\frac{10}{25}$ or ⅖ as many oxen; and 30 oxen multiplied by ⅖ are 12 oxen. And to eat up the growth of the 30 acres of grass during the 25 weeks, would require 3 times 10 oxen; and 10 oxen multiplied by 3 are 30 oxen. Lastly, 12 oxen, plus 30 oxen, are 42 oxen. *Ans.*

26. $\frac{\overline{26\frac{2}{3} \div {\cdot}2} \times 9}{40} = 30$ feet, the perpendicular. Now, $2\sqrt{40^2 + 30^2} = 100$. *Ans.*

27. The area of the whole triangle $= 18 \times 12 = 216$ sq. ft. As the triangle cut off is similar to the whole triangle, their areas are as the squares of their like sides. Therefore, $\frac{\sqrt{216}}{\sqrt{4}} : \frac{\sqrt{54}}{\sqrt{1}}$; that is, $2 : 1 :: 18 : 9$ base; $2 : 1 :: 24 : 12$ perpendicular; $\sqrt{12^2 + 9^2} = 15$ hypothenuse. *Ans.*

28. 1. Find the area of the triangle by the rule contained in a note at the end of the misc. examples, thus: $\frac{13+14+15}{2} = 21$. $21 - 13 = 8$; $21 - 14 = 7$; $21 - 15 = 6$; and $\sqrt{(21 \times 8 \times 7 \times 6)} = \sqrt{7056} = 84$ area.

$$\text{Now, } \sqrt{84} : \sqrt{24} :: \left\{ \begin{array}{l} 13 : 13\sqrt{\tfrac{2}{7}} = \tfrac{13}{7}\sqrt{14} = 6{\cdot}94879+ \\ 14 : 14\sqrt{\tfrac{2}{7}} = 2\sqrt{14} = 7{\cdot}48331+ \\ 15 : 15\sqrt{\tfrac{2}{7}} = \tfrac{15}{7}\sqrt{14} = 8{\cdot}01783+ \end{array} \right\}$$

Ans.

29. The pipe weighs $\frac{16 \times 16}{36} = 7\frac{1}{9}$ ounces per inch. Now, 11325 oz. : $7\frac{1}{9}$ oz. :: 1728 c. in. : $1{\cdot}085033112$ c. in. of pipe in 1 inch, and area of the end surface. ${\cdot}7854 \times 1{\cdot}25 \times 1{\cdot}25 = 1{\cdot}227187500$. And $1{\cdot}085033112 + 1{\cdot}227187500 = 2{\cdot}312220612$ area of the end; and $[\sqrt{(2{\cdot}312220612 \div {\cdot}7854)} - 1{\cdot}25] \div 2 = \frac{1{\cdot}7158 - 1{\cdot}25}{2} = {\cdot}2329+$ in. *Ans.*

Second Solution. 11325 oz. : 256 oz. :: 1728 c. in. : $39{\cdot}06119+$ solidity of 1 yard of pipe. Again, $1{\cdot}25 \times 1{\cdot}25 \times {\cdot}7854 \times 36 = 44{\cdot}17875$ cub. in. of cavity in 1 yard of pipe. Now, $44{\cdot}17875$ c. in. : $44{\cdot}17875 + 39{\cdot}06119 :: 1{\cdot}25 \times 1{\cdot}25 : 2{\cdot}944008+$ square inches = the square of the diameter of the external circumference of the pipe. But $\frac{\sqrt{2{\cdot}944003} - 1{\cdot}25}{2} = \frac{1{\cdot}7158 - 1{\cdot}25}{2} = {\cdot}2329+$ in. *Ans.*

30.
$$\left. \begin{array}{l} \sqrt[3]{(7^3 \times 3)} = 10{\cdot}09574+ \text{ feet long.} \\ \sqrt[3]{(4{\cdot}5^3 \times 3)} = 6{\cdot}49012+ \text{ feet broad.} \\ \sqrt[3]{(3^3 \times 3)} = 4{\cdot}32674+ \text{ feet deep.} \end{array} \right\} \textit{Ans.}$$

31. $1728 \div (\frac{1}{40})^2 \div {\cdot}785398 = \frac{1728 \times 1600}{{\cdot}785398} = 3520252{\cdot}69$ inches = 55 miles, 4 furlongs, 104 yards, 2 feet, 4·69 in. *Ans.*

NOTE. By using the decimal ·7854, the answer will be 55 m., 4 fur., 104 yds., 1 ft., 8·46 in., which is not so accurate as the first *ans.*

32. $\sqrt[3]{3} : \sqrt[3]{2} :: 20 : 20\sqrt[3]{\tfrac{2}{3}} = \frac{20}{3}\sqrt[3]{18} = 17{\cdot}4716+$ upper and middle. $\sqrt[3]{3} : \sqrt[3]{1} :: 20 : 20\sqrt[3]{\tfrac{1}{3}} = \frac{20}{3}\sqrt[3]{9} = 13{\cdot}8672+$ upper. And $17{\cdot}4716 - 13{\cdot}8672 = 3{\cdot}6044$ middle. And $20 - 17{\cdot}4716 = 2{\cdot}5284$ lower. *Ans.*

33. $118\frac{58}{89} \div 129\frac{39}{89} = \frac{10560}{89} \div \frac{11520}{89} = \frac{10560}{89} \times \frac{89}{11520} = \frac{10560}{11520} = \frac{22}{24} = 22$ carats fine. *Ans.*

34. 1. A got $\frac{2}{3}$, and B got $\frac{3}{8}$ of $\frac{2}{3} = \frac{6}{24} = \frac{1}{4}$. Then C got $\frac{3}{10}$ of $\frac{2}{3} = \frac{6}{30} = \frac{1}{5}$. Then $\frac{1}{4} + \frac{1}{5} = \frac{9}{20}$, and $\frac{2}{3} - \frac{9}{20} = \frac{13}{60}$, what A had left. D ran off with $\frac{6}{7}$ of $\frac{13}{60} = \frac{78}{420}$, and E secured $\frac{1}{7}$ of $\frac{13}{60} = \frac{13}{420}$; consequently A had none left. Hence, at the end of the first heat, B had $\frac{1}{4}$; C, $\frac{1}{5}$; D, $\frac{78}{420}$, and E $\frac{13}{420}$.

2. B let fall $\frac{2}{3}$ of $\frac{1}{4} = \frac{1}{6}$, and had $\frac{1}{12}$ left. D picked up $\frac{1}{3}$ of $\frac{1}{6} = \frac{1}{18}$, and

E the same quantity. Then D had $\frac{78}{420} + \frac{1}{16} = \frac{417}{1680} = \frac{139}{560}$. And E had $\frac{13}{420} + \frac{1}{16} = \frac{157}{1680}$. Therefore, at the end of the second heat, their shares stood thus: B, $\frac{1}{8}$; C, $\frac{1}{5}$; D, $\frac{139}{560}$, and E, $\frac{157}{1680}$.

3. A got $\frac{1}{4}$ of $\frac{1}{5} = \frac{1}{20}$; B got $\frac{1}{3}$ of $\frac{1}{5} = \frac{1}{15}$, and D got $\frac{2}{7}$ of $\frac{1}{5} = \frac{2}{35}$. Their sum is $\frac{1}{20} + \frac{1}{15} + \frac{2}{35} = \frac{73}{420}$, and $\frac{1}{5} - \frac{73}{420} = \frac{11}{420}$, what C had left. Then C took $\frac{1}{2}$ of $\frac{11}{420} = \frac{11}{840}$, and E took the same. B then had $\frac{1}{8} + \frac{1}{15} = \frac{23}{120}$; D had $\frac{139}{560} + \frac{2}{35} = \frac{171}{560}$. And E had $\frac{157}{1680} + \frac{11}{840} = \frac{179}{1680}$. Consequently, at the end of this engagement, their shares were as follows: A, $\frac{1}{20}$; B, $\frac{23}{120}$; C, $\frac{11}{840}$; D, $\frac{171}{560}$, and E, $\frac{179}{1680}$.

4. $\frac{1}{20} + \frac{1}{15} = \frac{35}{300} = \frac{7}{60}$, what A and B last acquired. D struck out of their hands $\frac{3}{4}$ of $\frac{7}{60} = \frac{21}{240} = \frac{7}{80}$. Then A had $\frac{1}{4}$ of $\frac{1}{20} = \frac{1}{80}$ left, and B had $\frac{1}{4}$ of $\frac{1}{15} = \frac{1}{60}$ left. They recovered in equal shares, $\frac{5}{8}$ of $\frac{7}{80} = \frac{35}{640} = \frac{7}{128}$; consequently, A took $\frac{1}{2}$ of $\frac{7}{128} = \frac{7}{256}$, and B took as much, that is, $\frac{7}{256}$. Then A had $\frac{1}{80} + \frac{7}{256} = \frac{51}{1280}$; and B had $\frac{1}{60} + \frac{7}{256} + \frac{1}{8} = \frac{649}{3840}$. Consequently, C had $\frac{11}{840} + \frac{7}{640} = \frac{323}{13440}$. And E, $\frac{179}{1680} + \frac{7}{640} = \frac{1579}{13440}$. Hence, their shares, after the fourth heat, were thus: A, $\frac{51}{1280}$; B, $\frac{649}{3840}$; C, $\frac{323}{13440}$; D, $\frac{1417}{4480}$, and E, $\frac{1579}{13440}$.

5. After the truce, each was to have $\frac{1}{5}$ of $\frac{1}{3} = \frac{1}{15}$; consequently, their shares stood as follows:

A's share was $\frac{51}{1280} + \frac{1}{15} = \frac{409}{3840} = \frac{2863}{26880}$.
B's share was $\frac{649}{3840} + \frac{1}{15} = \frac{905}{3840} = \frac{6335}{26880}$.
C's share was $\frac{323}{13440} + \frac{1}{15} = \frac{1219}{13440} = \frac{2438}{26880}$.
D's share was $\frac{1417}{4480} + \frac{1}{15} = \frac{5147}{13440} = \frac{10294}{26880}$.
E's share was $\frac{1579}{13440} + \frac{1}{15} = \frac{2475}{13440} = \frac{4950}{26880}$.

The sum of the numerators of the last fractions is equal to the common denominator, and, consequently, is the whole number of sugar-plums. Hence, the numerators express their respective shares. A had 2868; B, 6335; C, 2438; D, 10294, and E, 4950. Total, 26880. *Ans.*

35. By the question, B gains 3 miles a day on A, and C gains 5 miles a day on A and 2 miles a day on B.

First find how many days it will take B to overtake A, and how many days it will take C to overtake A and B; then the least common multiple of these numbers will be the first answer required.

3 m. : 90 m. : : 1 d. : 80 d. it will take B to overtake A
5 m. : 90 m. : : 1 d. : 18 d. it will take C to overtake A.
2 m. : 90 m. : : 1 d. : 45 d. it will take C to overtake B.

Now, the least common multiple of 80, 18 and 45 is 90. Hence, they will come together in 90 days. *Ans.*

$$\left.\begin{array}{l} \text{Now, 5 m.} \times \text{90 d.} = \text{450 miles, A travels.} \\ \text{8 m.} \times \text{80 d.} = \text{720 `` B ``} \\ \text{10 m.} \times \text{90 d.} = \text{900 `` C ``} \end{array}\right\} \textit{Ans.}$$

$$\left.\begin{array}{l} \text{And, } \dfrac{\text{450 m.}}{\text{90 m.}} = \text{5 times round A travels.} \\ \dfrac{\text{720 m.}}{\text{90 m.}} = \text{8 `` `` B ``} \\ \dfrac{\text{900 m.}}{\text{90 m.}} = \text{10 `` `` C ``} \end{array}\right\} \textit{Ans.}$$

$$\left.\begin{array}{l}\text{Now, } \dfrac{90\text{ d.}}{30\text{ d.}} = 3 \text{ times B will overtake A.}\\ \qquad\dfrac{90\text{ d.}}{18\text{ d.}} = 5 \quad \text{" \ C " \ " \ A.}\\ \qquad\dfrac{90\text{ d.}}{45\text{ d.}} = 2 \quad \text{" \ C " \ " \ B.}\end{array}\right\}\ \textit{Ans.}$$

NOTE. From this example we deduce the following rule, viz.: Find how many days it will take the *second* man to overtake the *first*; and how many days it will take the *third* man to overtake the *first* and *second*, &c., &c., and the *least common multiple* of the numbers will give the number of days after which they will meet again.

36. $1 - \frac{2}{3} = \frac{1}{3}$ remainder. And $\frac{2}{3}$ of $\frac{1}{3} = \frac{2}{9}$ to his younger. Now. $1 - \frac{2}{3} + \frac{2}{9} = \frac{27}{27} - \frac{24}{27} = \frac{3}{27} = \frac{1}{9}$ to his widow, and $\frac{2}{3} - \frac{2}{9} = \frac{6}{9} - \frac{2}{9} = \frac{4}{9}$. Hence, $\frac{4}{9}$ of the estate = \$750 ; and $\frac{1}{9} = \frac{1}{4}$ of \$750 = \$187'50 widow had. *Ans.*

37. $12 \times 2 = 24$; $20 \times 3 = 60$; $10 \times 7 = 70$, and $24 + 60 + 70 = 154$, A's product. $15 \times 1 = 15$; $9 \times 5 = 45$; $21 \times 6 = 126$, and $15 + 45 + 126 = 186$, B's product. And, $14 \times 2 = 28$; $18 \times 4 = 72$; $9 \times 5 = 45$; now, $28 + 72 + 45 = 145$, C's product ; and $154 + 186 + 145 = 485$. Then,

$$\left.\begin{array}{l}\text{A pays } \frac{154}{485} \text{ of \$75} = \text{\$23'814+}\\ \text{B pays } \frac{186}{485} \text{ of \$75} = \text{\$28'762+}\\ \text{C pays } \frac{145}{485} \text{ of \$75} = \text{\$22'422+}\end{array}\right\}\ \textit{Ans.}$$

38. Let *unity* on 1 represent A's share ; then $\frac{2}{3}$ will represent B's share ; and the ratio of the shares will be 1 : $\frac{2}{3}$ or $\frac{3}{2}$ or 3 to 2. Hence the question is simply to divide \$25 into 2 parts, which shall be in the ratio of 3 to 2. So that $\frac{3}{5}$ of \$25 = \$15 A's share, and $\frac{2}{5}$ of \$25 = \$10 B's share. *Ans.*

39. By allegation, thus :

$$\text{Average, } 6s. \begin{cases} 60s. \\ 6s. \\ 1s. \end{cases} \begin{array}{l} \text{5 cows.} \\ \\ \text{54 geese.} \end{array}$$

Here, by taking the differences, we have 5 cows and 54 geese. As the price of the sheep per head is the *average*, we must make up the complement of 100 in sheep, at the average price, which will require 41. Hence, 5 cows, 41 sheep, and 54 geese. *Ans.*

40.

$225 \times$ \$2'58⅓	= \$ 581'25	$3000 \times$ \$0'20⅚	= \$ 625'00
$37 \times$ \$8'33⅓	= \$ 308'33⅓	$2700 \times$ \$0'07$\frac{23}{36}$	= \$ 206'25
$12 \times$ \$2'33⅓	= \$ 28'00	$1500 \times$ \$0'11$\frac{29}{36}$	= \$ 177'08⅓
$19 \times$ \$1'50	= \$ 28'50	$19 \times$ \$2'04⅙	= \$ 38'79⅙
Cash,	\$ 424'00		
Charges,	\$ 125'33⅓	Bought,	\$1047'12½
Sold,	\$1495'41⅔	Loss,	\$ 448'29⅙

Ans.

41. $19\frac{4}{5} \times 4 = 79'2$ miles, perimeter of the square. And $19'8 \times 3'14159 = 62'203482$ miles, circumference of the inscribed circle. Now, $79'2 - 62'203482 = 16'996518$ miles = 16 miles, 318 rods, 14 feet, 7 in., 1 b. c. *Ans.*

42. 15) 77° 1′ 30″

5h. 8m. 6s. difference in time. From midnight to 3½ o'clock in the afternoon, are 15 h. 30 m. Now, 15 h. 30 m. — 5 h. 8 m. 6 s. = 10 h. 21 m. 54 s. So that the time at the capitol in Washington, will be 10 h. 21 m. 54 s., A. M. *Ans.*

43. *Inversely*, 11½ : 12 : : 46 lbs. : 48 lbs. *Ans.*

44. 11‘37 oz. : 63 oz. : : 1 c. in. : $5\frac{205}{379}$ c. in., bulk in gold. 6‘42 oz. : 63 oz. : : 1 c. in. : $9\frac{87}{107}$ c. in. bulk in silver. $6\frac{3}{4} = \frac{1094931}{162212}$; $5\frac{205}{379} = \frac{898800}{162212}$; $9\frac{87}{107} = \frac{1591800}{162212}$.

$$1094931 \begin{cases} 898800 \\ 1591800 \end{cases} \begin{matrix} 496869 \\ 196131 \\ \hline 693000 \end{matrix} : 63, \text{ or}$$

11000 : 1 : : 496869 : 45 oz., 8 pwt., $9\frac{153}{275}$ grs. gold.
11000 : 1 : : 196131 : 17 oz., 16 pwt., $14\frac{122}{275}$ grs. silver. *Ans*

45. 2 : 5 : : 3 : 7½. *Ans.*

46. £19 1*s.* 9½*d.* = 4581½ pence; and 3*s.* 6*d.* = 42 pence. Now, $\sqrt{\left(\frac{4581‘5 \times 2 \times 9}{42}\right)} \div ‘7854 = 50$ feet. *Ans.*

47. $4\sqrt{(43560 \div ‘7854)} = 4\sqrt{55462‘184+} = 4 \times 235‘5041606$ = 942‘0166424 feet. *Ans.*

Note. By using the more accurate decimal, ‘785398163397, the answer is, 942‘017533 feet.

48. £ stg. 46‘725 : £ stg. 800.000.000. : : 11 oz. troy, : $188336008\frac{1048}{1869}$ oz. troy, *pure gold.* Now, $\frac{175}{1}$ oz. troy : $\frac{352000000000}{1869}$ oz. troy, : : $\frac{192}{1}$ oz. avoird. $= \frac{1}{175} \times \frac{352000000000}{1869} \times \frac{192}{1} = \frac{1}{7} \times \frac{14080000000}{623} \times \frac{64}{1} = \frac{901120000000}{4361} = 206631506\frac{2334}{4361}$ oz. avoird. And, $\frac{901120000000}{4361} \div \frac{19258}{1} = \frac{901120000000}{4361} \times \frac{1}{19258} = \frac{45056000000}{4361} \times \frac{1}{9629} = \frac{450560000000}{41992069} = 10729\frac{27091699}{41992069}$ cubic feet of pure gold = 10729‘6451+ c. feet. Now, $\sqrt[3]{10729‘6451+}$ = 22‘05+ feet, side of the cube. And, $\sqrt[3]{(10729‘6451+ \div ‘5236)} = \sqrt[3]{20492‘064} = 27‘36+$ feet, diameter of the globe. *Ans.*

49 4½ lb. = 54 oz. = weight of bottle. $\frac{54}{1‘36}$ = 39‘7059 c. in. in the bottle. 281 c. in. in the brandy. 270‘7059 c. in. in bottle. Then, 270‘7059 × ‘5427 = 146‘912 oz. = weight of salt water occupied by the bottle and brandy. And, 48927 = weight of a cubic inch of brandy × 281 = 113‘02 oz.; and 113‘02 + 54 = 167‘02 oz. = weight of the bottle and brandy. From this take the weight of the salt water, viz.: 146‘912 oz. and it leaves 20‘11 oz. *Ans.* Supposing the bottle full, it is 20‘11 oz. heavier than the same bulk of salt water, and, therefore, will sink.

$$\begin{array}{lr} 50.\ A + B + C + D & = 50000 \\ \ B + C + D + E & = 66000 \\ A + C + D + E & = 60000 \\ A + B + C + E & = 56000 \\ A + B + D + E & = 64000 \\ \hline & 296000 \end{array}$$

Then, 296000 ÷ 4, the number of combinations, = 74000 = the sum of their fortunes. Then,

$$\begin{array}{lr} A + B + C + D + E & = 74000 \\ \text{and } A + B + D + E & = 64000 \\ \hline \text{Miss Jane's fortune,} & £10000. \end{array}$$ *Ans.*

51. The greatest number of different remainders cannot exceed the number of units in the divisor, less *one.* See example 8 of the "Addenda."

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